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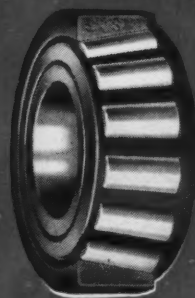
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Chicago, May 1, 1926

(Issued Every Other Week)

Volume XXIX, No. 9

SHOCK-PROOF, thrust-proof, power-saving Timken Bearings are in the Koehring Dandie Mixer, as in so much of the finest machinery. In Timken-equipped machines no moving parts last longer than the bearings! The Timken Roller Bearing Company, Canton, Ohio



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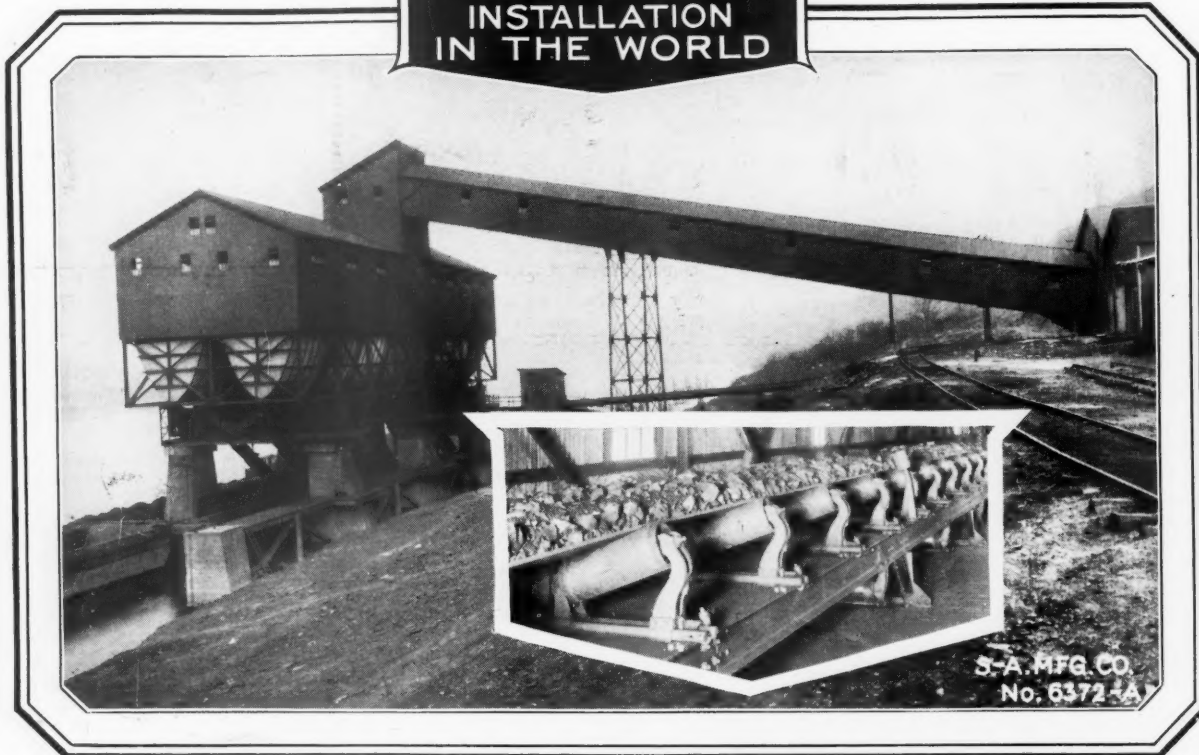
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May 1, 1926

Rock Products

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On April 14th

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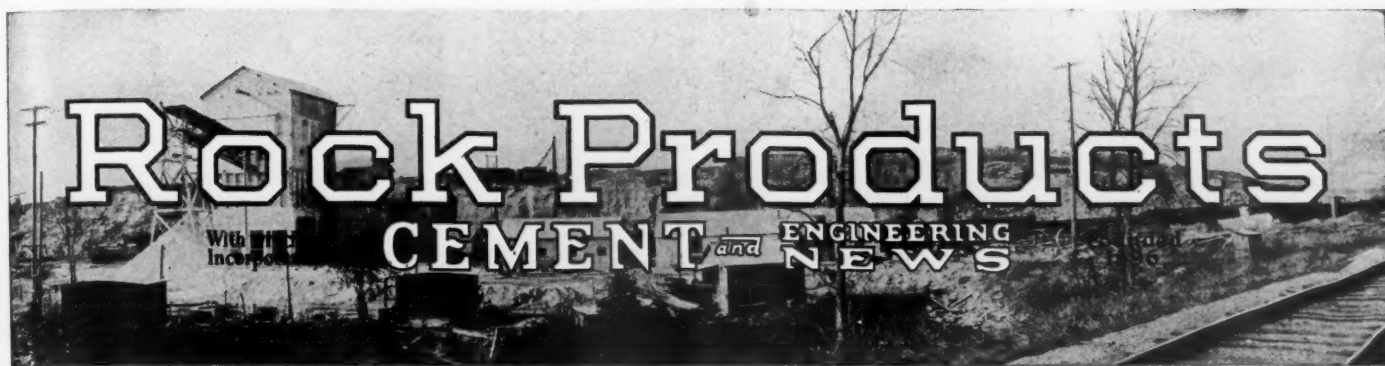
Write for Bulletin No. 1430 Illustrating and Describing this Style "444" Belt Conveyor Carrier

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Volume XXIX

Chicago, May 1, 1926

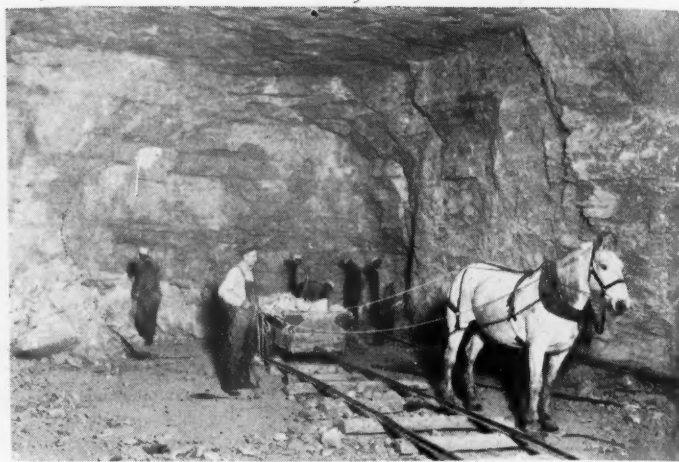
Number 9

Mining Stone in the Kansas City District

Clay County Crushed Stone Company Secures High Grade
Rock by Underground Methods in Birmingham, Missouri



This flash light picture shows the face of a breast in the mine of the Clay County Crushed Stone Co. One of the pillars which is to be left shows at the right of the picture



Left—The drifts diverge at a 60-deg. angle with pillars at the apex. Right—Horses are used to pull loaded cars to the foot of the plant incline

THE practice of mining limestone is increasing. As the U. S. Bureau of Mines has pointed out, it was bound to increase as the situations for quarries were taken up and as quarries which had much overburden to remove found the overburden growing heavier as the quarry went into a hill. Both these conditions exist in the Kansas City district where some companies have been operating mines for cement stone for years. So the crushed stone producers find that many of them must turn to mining in order to pro-

duce a material that will meet the more rigid specifications now being demanded for highway work and for all of the better class of construction.

It is not so uncommon to see mining stone displace open quarrying, but it is unusual to see a company open a mine and build a plant without passing through the open quarry stage. This is what the Clay County Crushed Stone Co. of Birmingham, Mo., six miles from North Kansas City, has done, and while the operation is not a large one,

it is interesting because the operation is a success both technically and financially.

The rock which is being mined is the Bethany Falls ledge, which belongs to the Pennsylvanian rocks. There are a number of ledges of this system which outcrop near Kansas City. Some are too soft, others contain a large proportion of chert (which the state highway department will not accept if the chert is more than 5% of the whole) and other ledges are broken by shale seams and clay filled cracks so small that they can-



Cars are drawn up the incline at the left to the primary crushing plant. The crusher product is elevated to the screening plant which is above the bins

not to be quarried separately, to leave a clean stone. The Bethany Falls ledge, which is the only one that will make highway specification stone, lies below most of these other ledges and its working has cost heavily for removing the overburden and quarrying a lot of waste rock that could not be sold.

At Birmingham the exposed face appears about 60 ft. high. The lower 24 ft. is the Bethany Falls ledge, almost all of which is solid and firm, as shown quite plainly in the photograph. The ledge above is broken and shaley and not sound enough to serve as a roof. So the full height of the ledge cannot be shot down, as a considerable thickness has to be left for a roof.

The method chosen for mining is to run in a breast $7\frac{1}{2}$ ft. high on the lower part of the ledge. Then a 5 ft. slab is taken from the roof and later another 5 ft. slab. This leaves $6\frac{1}{2}$ ft., a part of which is too shaley and cherty to make a good crushed stone, to form the roof.

The breast is carried about 30 ft. wide. After this has been run in at a right angle to the face of the ledge for a short distance two more breasts are started, advancing



The Bethany Falls ledge is the lowest stratum in this picture

in directions which make a 60 deg. angle, leaving a pillar at the apex. Later other breasts will be advanced in pairs making a 60 deg. angle and leaving a pillar. The

ground after working out will show a series of pillars forming equilateral triangles. Those who have read J. R. Thoenen's articles on the mining of limestone and gypsum



Quarry cars from the mine being pulled up to the primary crusher and empties going back through another opening

rock which appeared in **ROCK PRODUCTS** in 1924-25 will remember his discussion of this method and the diagrams accompanying it.

Denver Rock Drill Co.'s "drifters" and "stoppers" are used in this work, the "drifters" for advancing the breast and the "stoppers" for putting the holes in the rock above to break this to the roof. The roof stands well and there are no signs of slabbing or cracking.

The men say they like the underground work. It is cool in summer and warm in winter underground and rain and snow do not affect the work at all. Work can go on at night as well as in the day.

The broken stone is loaded into low cars which were built at the plant and is brought outside by a horse. There are three openings which are drawn from in turn. The advancing drifts have been connected with these three openings thus providing good ventilation within the mine. All loaded cars are taken out of the opening directly at the foot of the incline.

A horse draws the cars to the foot of a short incline, up which they are pulled by a small friction hoist. They are dumped into the mouth of a No. 6 Austin crusher. The crushed rock falls into a scalping screen with 2¼ in. openings and the screen is set so that the oversize falls directly into a No. 4 Aus-



L. R. Peairs, secretary and treasurer

tin crusher. The undersize and the product of the No. 4 crusher go to an Allis-Chalmers sizing screen, 40 in. by 14 ft., with 1½ in. and 1 in. perforations and a dust jacket. All products go to bins except the oversize, which goes back to the No. 4 crusher by a belt conveyor. As much of the material as is possible is made to conform to highway



J. F. Rhodes, president of the company

specifications and this includes everything but "chats" and screenings. "Chats" is the local name for "half-inch" stuff.

An 8-mesh hexagonal screen has been installed to be fed with the chats and screenings. The undersize will be sold as agricultural limestone and the oversize will be utilized as a concrete products aggregate.

The plant is producing only six cars daily, but this production will be increased as the mine is opened and more faces are worked. The demand for this rock is far greater than the little plant can supply. Foundations are in place for a No. 10 crusher which will be set as soon as the mine can produce enough to keep it going.

J. F. Rhodes is president of the company, C. R. Barrell is vice-president and L. R. Peairs is secretary and treasurer. Mr. Rhodes has been in the lime and stone business all his life and so were his father and grandfather before him. His son has been working at the plant during his school vacation and promises to carry on the family tradition. Formerly Mr. Rhodes was president of the New Castle Lime and Stone Co. at Hillside, Penn. Before coming to Kansas City (he came with the Consolidated Crushed Stone Co.) he was employed by the Lehigh Lime and Stone Co. at Mitchell, Ind.

Charles Briney, who aided Mr. Rhodes in the designing of the crushing plant and superintended its erection, is master mechanic of the Consolidated Crushed Stone Co. and was also with the Lehigh company at Mitchell, where he was master mechanic. He is a great advocate of safety first work which he helped to introduce in the Lehigh plants that won the cement safety trophy.

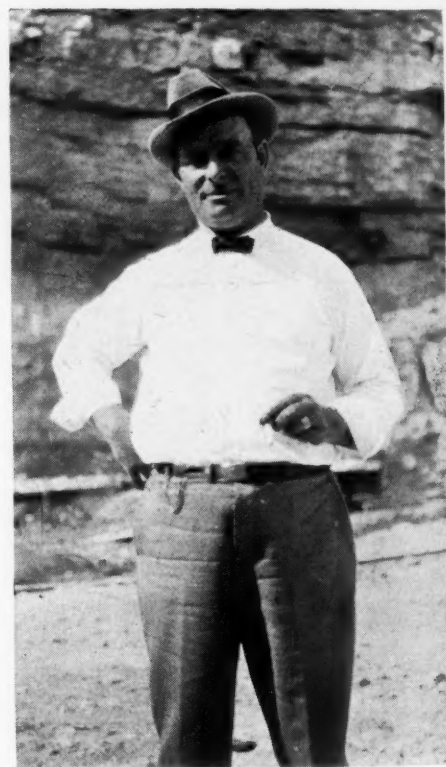
The difficulties of removing heavy overburden in open quarrying and the general scarcity of good rock for crushing purposes

makes the price of crushed stone in Kansas City 30 to 40 cents more than the average price throughout the United States. For this reason mining can compete with open quarrying.

American Refractories Institute Annual Meeting

ACCORDING to a recent announcement, the American Refractories Institute will hold its annual meeting at the Bellevue-Stratford hotel, Philadelphia, Penn., on May 12, beginning at 10 a. m. (daylight saving time). Among the papers to be presented, the following should be of interest to rock products producers:

"Mullite Refractories," by M. L. Freed, research fellow, U. S. Bureau of Standards, Washington, D. C.; "Industrial Research," by Dr. E. R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Penn.; "The Study and Development of Tests for Fire Brick with Special Reference to Spalling," by S. M. Phelps, fellow, Refractories Fellowship, Mellon Institute, Pittsburgh, Penn.; "Permeability as a Measure of the Uniformity of Fire Brick," by Dr. A. E. R. Westman, research fellow, University of Illinois, Urbana, Ill.



Charles Briney, who assisted in the design of the plant

Arrangements are also being made to have one or two nationally prominent speakers present and talk on subjects of general interest.

At noon a luncheon will be served in the hotel, reservation for which should be made through Dorothy A. Texter, secretary, 2202 Oliver building, Pittsburgh, Penn.

Hydraulic Stripping at the Acme Limestone Quarry

A West Virginia Company Takes Advantage of Grade and Water Supply for Removing Overburden

WHEREVER conditions are right, hydraulic stripping is one of the most satisfactory methods of cleaning off a quarry. This is especially true if the rock contains deep seams, too narrow to permit the use of a steam shovel, from which it is expensive to dig the overburden by hand. Water washes the dirt out

carry the water with its burden of suspended solids away from the work.

These are all present at the quarry of the Acme Limestone Co. of Alderson, W. Va., and the stripping of this quarry by hydraulic methods has been very successful. In part this is due to the sound engineering principles that have been fol-



The pipe line which brings the water to the quarry face



One of the ditches carrying strippings across the quarry floor

of these seams as easily as it washes off a flat surface. But in spite of its many advantages hydraulic stripping can be used in only a limited number of places, for there must be a water supply fairly close to the operation, a place to run the water and strippings from the quarry, and above all the necessary grade to



Flume which takes the flow from the quarry under the track



Left—Washing dirt from rough ground. Right—One of the 4-in. metal wound hose lines that brings water from one of the pipe branches to the nozzle



Left—A deep and narrow channel which has been thoroughly cleaned out by the stream from the nozzle. Right—The ground washed clean all ready for the drills

lowed in installing the hydraulicking equipment and method, for hydraulicking demands rather more attention to the layout and carrying on of the work than other excavating methods.

Water for stripping this quarry is pumped 400 ft. from the Greenbrier river through an 8-in. American Spiral Pipe Works riveted pipe. The main line is laid 150 ft. back from the face and tees at 200 ft. intervals permit branches to be taken off for the sluicing nozzle. An Allis-Chalmers 4-in., four-stage pump driven by a 200 hp. Allis-Chalmers motor not only raises the water but gives it the necessary force to be used in sluicing.

The branches taken off are of 4-in. pipe terminating in a 4-in. hose. The nozzle used is a special stripping nozzle made by the Universal Nozzle Co. of Indianapolis, Ind. It has different size tips, from 1-in. to 1½-in. in diameter. The largest size is most used. For getting into close places a 2½-in. hose and small nozzle is connected, and for this the pressure is regulated so that it will not exceed 100 lb. But this is not used where the 4-in. hose can be used.

The water with its burden of strippings falls over the quarry face and is caught in a ditch close to the face. From this it is run in ditches across the quarry floor and these are gathered in a flume which carries it under the railroad tracks which serve the quarry and back into the river. This has sufficient current to carry the dirt away from the locality.

The overburden is a red clay which is not hard to cut by the stream from the nozzle. It goes into suspension readily and the water carries a heavy percentage of solids the greater part of the time.

The photographs with this show how successfully this method cleans out the narrow seams and potholes, leaving the rock washed clean and ready for the drills. They also show the well built ditches and flume by which the water is returned to the river. The company writes that it considers this method a thorough success.

Quarrymen Discuss Accident Prevention Methods

By D. C. Souder

Secretary of Quarry Section, National Safety Council, and Director of Insurance and Safety, France Stone Co., Toledo, Ohio

A QUARRY accident prevention meeting was held at Toledo, Ohio, on April 16 under the auspices of the Quarry Section of the National Safety Council. About 45 representatives were present and E. E. Evans, chairman of the Quarry Section, presided.

T. P. Kearns, superintendent, Division of Safety and Hygiene, the Industrial Commission of Ohio, Columbus, Ohio, spoke on a proposed quarry code for the state of Ohio. The code will consist of rules and regulations applying in and about quarry operations and will tend to eliminate accident hazards. It will be thoroughly introduced by meetings held in different parts of Ohio and a committee will be appointed, partly consisting of quarry operators, to consider all additions or alterations made by any operator or other authority to a tentative code. An actual code will then be drawn up, adopted and made a state law.

Jay E. Thompson, secretary of the Toledo Safety Council, gave a practical demonstration of first aid in accidents that may occur in and about stone quarrying operations. This demonstration was very clear and thorough, Mr. Thompson using a representative in his audience as a model in which to display the various methods of applying first aid.

Following Mr. Thompson's demonstration, all representatives enjoyed luncheon especially prepared for the meeting.

J. R. Davis, superintendent of the United States Gypsum Co. at Genoa, Ohio, after operating his plant for a period of 12 consecutive months without any lost time on account of accidents, and employing an average of 350 men the year round, talked concerning the manner

in which he was able to accomplish such a record in their industry.

Mr. Davis stated that his method of putting the safety proposition across was strictly a salesmanship problem—selling safety to your employees just the same as selling your product. Higher officials must be your general sales managers or, in this case, as the men behind the safety movement. Lineage, as in your sales department, must be carried on down to your foremen and have them perform the educational work among the workers.

Frank F. McLaughlin of the France Stone Co. gave a talk on the handling and uses of explosives and from the discussion which followed with explosive representatives, it was the opinion that his speech was very interesting and instructive and it is believed a great deal of good was derived from this phase of the meeting.

Following Mr. McLaughlin's talk a motion picture was shown displaying the methods which the Ford Motor Co. employs in its plants to enforce safety. Also the motion picture, "A Modern Blast," furnished by the Hercules Powder Co., was shown.

A bronze "Explosives Engineer" trophy which will be awarded by the Bureau of Mines, Washington, D. C., to the quarry or mining industry having the best accident record for the year 1925 was on display during the meeting and created much favorable comment. Numerous safety bulletins for use in the industry were also on display.

Chairman E. E. Evans gave a short talk immediately after the motion pictures were shown and concluded the meeting.

Screening Equipment for Rock Products

Screens of High Efficiency Are Now Required

By Hugo W. Weimer
Consulting Engineer, Milwaukee, Wis.

EQUALLY as important as the crushers discussed in previous articles is the screening equipment in the modern rock products plant. The mere fact that a screen of some size and type was installed, was sufficient evidence in years past that proper screening was being done. Such is not the case at the present time, exacting material specifications followed by close inspection making it necessary that the screening unit in a plant really makes the separation required. Stone may be classified by various devices, such as the stationary bar grizzly, a number of rotary types of grizzlies, revolving screens, shaking type screens or the vibratory type of screen. In this article the revolving, shaking and vibrating screens only are discussed.

Rotary Screens

The revolving, rotating or rotary screen, as it may be termed, is an old and well known device for the sizing of stone and similar material. Even though other types may be more efficient for fine screening and in some particular cases for coarse material, it has a certain field of usefulness that cannot at this time be filled by any other method with equal success so far as cost and performance are concerned. For the sake of brevity the remarks under this heading will be confined to the types particularly

adapted to and most used in the stone industry. The first type in general use is shown in Fig. 1, which has a central supporting shaft with spiders extending radially from the center to which the screen surface is attached.

While it is simple in construction, and consequently low in cost, it cannot be used to best advantage for heavy duty nor for a screen very large in diameter nor for any great length of screen. The obstruction caused by the center shaft to the feeding of material into the screen, and the spiders and arms to the free passage of material

through the screen, limit the use of this type. Figs. 2 and 3 illustrate a design of semi-roller type now in general use. A head at each end connected lengthwise by structural members which support the screen sections and a two roller support at the feed end and a center bearing with bevel gear drive at the discharge end constitute the construction of this screen. The discharge end is shown in Fig. No. 2 and the feed end in Fig. No. 3. The all roller type is illustrated in Figs. 4 and 5. The first mentioned shows a screen for light or medium duty with a spur gear drive and the other a heavy duty type of all roller screen with bevel gear drive and thrust rollers at the discharge end.

Figs. 6 and 7 show the recent design of a rollerless rotary screen. The discharge end is similar to other types, but the feed end

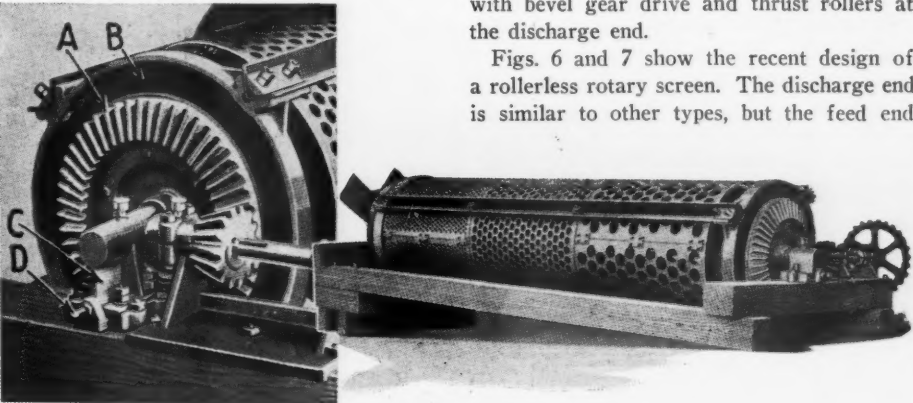


Fig. 2. Semi-roller type showing discharge end

ROTARY SCREEN DATA												
Table No. I.												
Screen diameter, inches.....	24	32	40	48	60	72						
Average feed, tons per hour.....	17	35	55	85	125	150						
Peripheral speed, feet per minute.....	145	175	190	190	190	190						
Revolutions per minute.....	23	21	18	15	12	10						
Horsepower per foot of length.....	.5	.6	.7	.8	1.0	1.4						

Table No. II.												
Ring size of product and tons per hour per foot of length												
Screen diameter in in.	Maximum ring size in in.	1/2 in.	3/4 in.	1 in.	1 1/4 in.	1 1/2 in.	1 3/4 in.	2 in.	2 1/2 in.	3 in.	3 1/2 in.	4 in.
24-inch.....	1	1.5	2.0	2.3								
	2	1.9	1.2	1.5	1.7	2.0	2.1	2.3				
	3	.7	.9	1.1	1.3	1.5	1.7	1.8	2.0	2.3		
32-inch.....	1	2.5	3.2	3.7								
	2	1.5	2.0	2.5	2.8	3.2	3.4	3.7				
	3	1.0	1.5	1.8	2.2	2.5	2.7	2.9	3.3	3.7		
40-inch.....	1	3.5	4.5	5.2								
	2	2.1	2.8	3.5	4.0	4.5	4.9	5.3				
	3	1.5	2.1	2.6	3.1	3.5	3.8	4.2	4.7	5.3		
	4	1.2	1.7	2.1	2.5	2.8	3.2	3.5	4.0	4.5	4.9	5.3
48-inch.....	1	4.2	5.4	6.3								
	2	2.5	3.4	4.2	4.8	5.4	5.9	6.3				
	3	1.8	2.5	3.1	3.7	4.2	4.6	5.0	5.7	6.3		
	4	1.4	2.0	2.5	3.0	3.4	3.8	4.2	4.8	5.4	5.9	6.3
	5	1.1	1.6	2.1	2.5	2.9	3.2	3.6	4.2	4.7	5.2	5.6
60-inch.....	1	5.2	6.7	7.8								
	2	3.1	4.2	5.2	6.0	6.7	7.3	7.8				
	3	2.2	3.1	3.8	4.6	5.2	5.7	6.2	7.1	7.8		
	4	1.7	2.5	3.1	3.7	4.2	4.7	5.2	6.0	6.7	7.3	7.8
	5	1.4	2.0	2.6	3.1	3.6	4.0	4.5	5.2	5.9	6.5	7.0
	6	1.2	1.7	2.2	2.7	3.1	3.5	3.9	4.6	5.2	5.8	6.3
72-inch.....	1	6.3	8.1	9.4								
	2	3.7	5.1	6.3	7.2	8.1	8.8	9.4				
	3	2.7	3.7	4.6	5.5	6.3	6.9	7.5	8.5	9.4		
	4	2.1	3.0	3.7	4.5	5.1	5.7	6.3	7.2	8.1	8.8	9.4
	5	1.6	2.4	3.1	3.7	4.3	4.8	5.4	6.3	7.0	7.8	8.4
	6	1.4	2.1	2.7	3.3	3.7	4.3	4.7	5.5	6.3	7.0	7.5

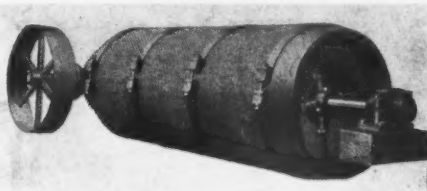


Fig. 1. Simple revolving screen

costly ones, have been made by not installing sufficient screening area. The cost of good and sufficient screening capacity is but slightly more than inefficient equipment and when given due consideration the screens in a plant will not be the bottleneck as they are in many installations and thus produce an inferior grade of product. To assist in choosing the correct diameter and length of

screen necessary, the writer has prepared the data as given in tables No. 1 and No. 2. The various illustrations show the types in general use which, together with the data, should be sufficient to make an intelligent estimate for the ordinary rotary screen installation.

The average tons per hour of feed for a given diameter are listed in table No. 1, but are subject to change owing to certain working conditions. For exceedingly fine and efficient screening the figures may be high, whereas for scalping, when screening efficiency is not necessary, they may be increased, but as given they can be considered a fair average. The peripheral speed of the screen drum is an important factor and more often than not screens are operated at too great a speed. Practical experience has demonstrated that a peripheral speed of about 190 ft. per minute will do the best work, except for the smaller diameters which are run slightly slower. The approximate power required for each lineal foot of screen is also given in table No. 1.

It is well to remember that screens should have a uniform flow of feed at not too great a velocity to obtain the best results. While in years past the slope or inclination of revolving screens was considered best at about $1\frac{3}{4}$ -in. rise per foot, it has been proven that about $1\frac{1}{4}$ -in. per foot will best answer the purpose for most installations.

As regards the length of screen, this of course is governed by the number of products required and also by the tonnage necessary to pass through the perforations. To

obtain the necessary length for the various perforations, table No. 2 was prepared. The data was based on Brownell McGrew's formula as published in *Rock Products*. Mr. McGrew's practical experience together with his technical knowledge makes him particularly well fitted to prepare such a formula.

To determine the necessary length of a screen section, the governing factors entering into the calculations in this formula are: The number of tons per hour to be screened through the section; the maximum ring size (taken at the 80 or 85% point) of the bulk of the material passing through

Minus 1 in. 30 tons, plus 1 in. and minus $1\frac{1}{2}$ in., 19 tons, plus $1\frac{1}{2}$ in. and minus 2 in., 15 tons and plus 2 in., 11 tons. By referring to table No. 1 it will be noted that a 48-in. diameter screen will probably be satisfactory. The maximum ring size of feed in this example at the 85% point is 2 in., because 85% of all the feed to the screen is 2 in. or less in size.

By referring to table No. 2, 48-in. screen

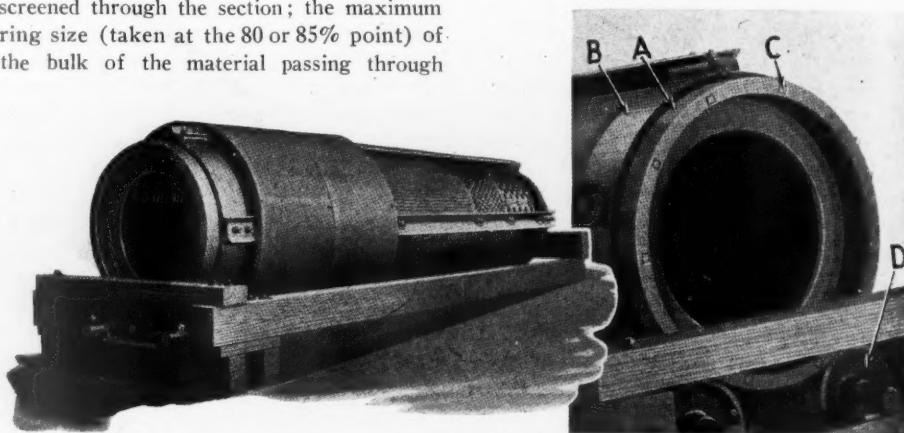
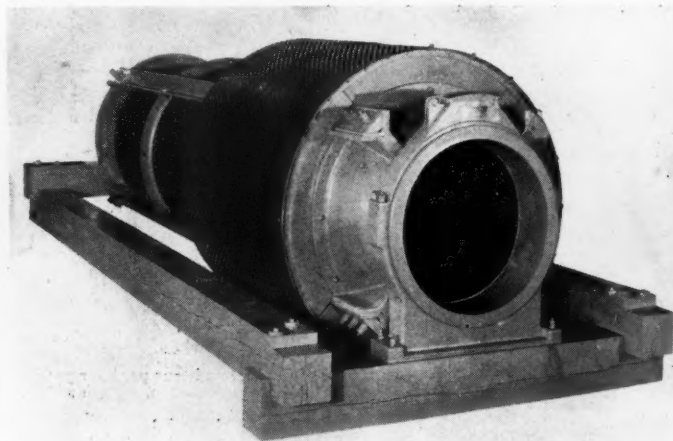
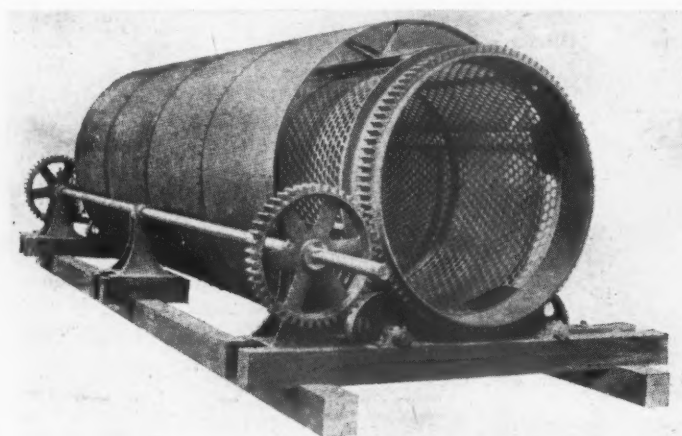


Fig. 3. Semi-roller type showing feed end

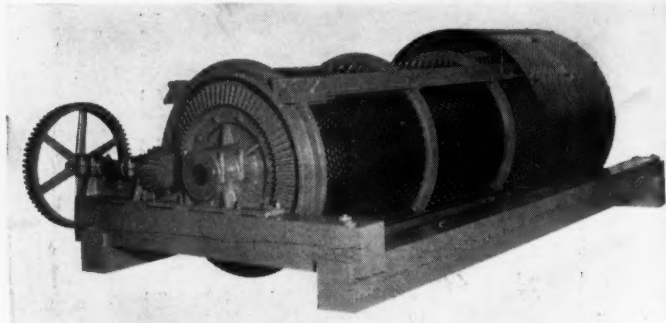
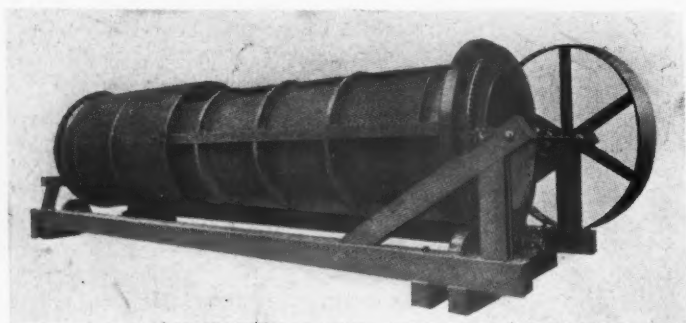
the barrel of the screen, and the ring size of the material to be separated.

As an example let us assume a case where the feed to the screen will be 75 tons per hour and the number of separations together with the tonnage of each is as follows, all based on ring size of product:

diameter and a maximum ring size of feed of 2 in., we find that to produce a ring size product of 1 in., each foot of length will take care of 4.2 tons per hour. Thus dividing 30 (the required tonnage) by 4.2, we find that the length of this section should be 7 ft. For the $1\frac{1}{2}$ -in. product divide 19



Left—Fig. 4. The full roller type showing gears for driving. Right—Fig. 7. Feed end of new rollerless screen



Left—Fig. 5. An all-roller screen of heavy construction. Right—Fig. 6. End drive of the rollerless screen

by 5.4 and a 4 ft. 0 in. section is found necessary. For the 2-in. product divide 15 by 6.3 and we obtain a length of 2 ft. 6 in. Thus the total length of the screen will consist of sections 7 ft., 4 ft. and 2 ft. 6 in. long, which the writer would change to 8 ft., 4 ft. and 4 ft. in order to make all sections of equal length or in multiples of four,

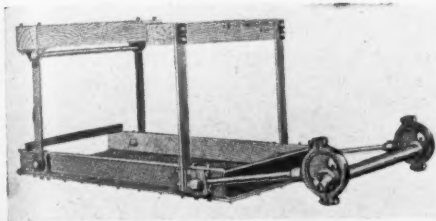


Fig. 8. Suspended shaking screen

which would mean that a screen 48 in. in diameter by 16 ft. long would be necessary to accomplish the desired results.

The perforations in the sections must necessarily be larger in diameter than the ring size of product, which point is illustrated in the writer's article in *ROCK PRODUCTS* of January 23, and will be further discussed in following articles. The figures given in the table are based on the ordinary crusher run of feed as produced in the average stone crushing plant, fairly free from foreign matter and with the usual moisture conditions.

Since a dust jacket is larger in diameter than the main sections, the peripheral speed is also greater, in fact the speed is so much more that the screening efficiency per foot of length is considerably less than for the main sections. Also the fact that the dust jacket receives its feed along the greater

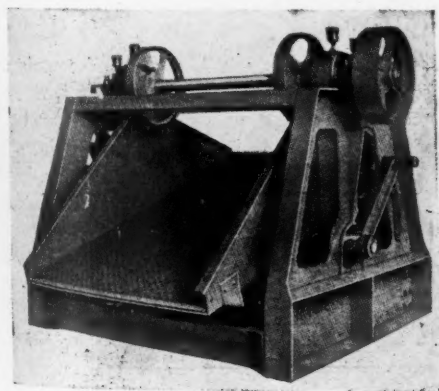


Fig. 10. Shaker with eccentric drive

portion of its length and the excess percentage of fines occasionally in the feed make it necessary to be very liberal in figuring the length of jacket necessary. Table No. 2 may be used for calculating dust jacket lengths by assuming the jacket the same as the main section diameter and using one-half of the tonnage figures given in the table.

Suppose in the previous example the 30 tons of minus 1 in. consisted of 15 tons minus $\frac{1}{2}$ in. and 15 tons plus $\frac{1}{2}$ in. and

minus 1 in. and a separation was to be made by a dust jacket. Fifteen tons of $\frac{1}{2}$ in. ring size is to be screened through the jacket and the maximum ring size of feed is 1 in. In table No. 2, 48 in. screen diameter, 1 in. maximum feed, for $\frac{1}{2}$ in. product we find listed 4.2 tons per foot of length. Dividing 15 by one-half of 4.2 or 2.1 we obtain the necessary length of jacket as 7 ft., which works out nicely with the length of the first main section, which is 8 ft. long. The jacket should always be 6 in. to 12 in. shorter than the first screen section.

The original design of shaking screen was a simple arrangement of an inclined suspended screening surface given its reciprocating motion by means of an eccentric connected to the screen frame by a rod.

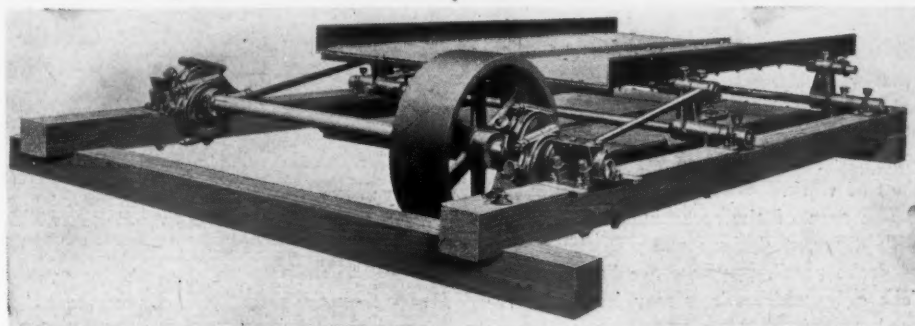


Fig. 9. Modern version of the shaking screen

This type of screen is usually placed at a slight angle of inclination varying from about 3 to 10 deg. The construction of the shaking screen being such a simple matter, many operators built their own screens and obtained results in many installations that were quite satisfactory. Many variations of design have been built by manufacturers and no doubt most operators are familiar with the principle of operation and the various types used. The numerous reciprocating parts naturally make necessary many points for lubrication, which together with the excessive wear on these parts and with some types the vibration transmitted to the supporting structure, have tended to make the shaking type of screen rather unpopular.

Fig. 8 illustrates the suspended type with two steel and two hickory hangers. The wooden hangers act in the nature of a flat spring and provide a simple support. In Fig. 9 is shown a modern version of the shaking screen with two decks and two sets of eccentrics and rods which provide a balancing feature and tends to eliminate the danger of the horizontal shake being transferred to the building or supports. To eliminate knocks due to loose parts a compensating spring arrangement is provided between the rocking supports for the upper and lower decks which tends to keep the eccentric rods under tension at all times.

Fig. 10 shows a shaking screen with a different arrangement for the eccentric drive. It consists of a steel frame to which the screening surface is attached, which is hung from an overhead shaft. The hangers

connect to the shaft by means of eccentrics, thus the rotation of the shaft tends to give a vertical motion to the screen surface, which however is changed to a forward and backward movement by the pivoted lever arms fitted at one end to a shaft fastened to the under side of the screen deck and attached to the side frames at the other end. The angle of slope recommended for this screen is from 10 to 18 deg.

The popularity of this type of screening device for fine work, and in many installations for coarse separation, is sufficient evidence of its usefulness in the stone crushing industry. Progress again has shown its mark and a study of the various types of vibrating screens being manufactured today reveals the fact that each make has its dis-

tinctive method of vibration. The majority of vibrating screens have a mechanical method for producing the necessary vibration, each in a different manner and giving an action unlike any other. It is well for the operator to understand thoroughly the various principles so that no error will be made in the installation of an apparatus that is not suitable for the working requirements. The following paragraphs will explain to a cer-

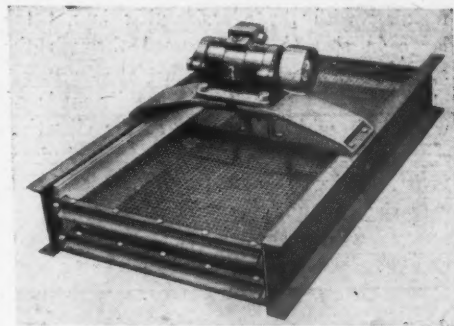


Fig. 11. Screen vibrated by a bar

tain extent, and, the figures will illustrate, the various designs. It is the writer's opinion that vibrating screens will play even a greater part in the screening field in the future than they have in the past.

Unlike the eccentric type shaking screens, most designs of vibrating screens must be set at a greater angle of slope in order to pass the material over the screening surface. This angle varies with different makes from 20 to 50 deg.

While it is claimed that the vibrating type

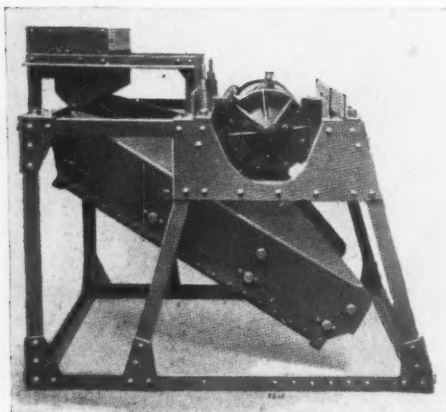


Fig. 13. Vibrated by electric motor

will screen dry, damp or wet material, most operators are well aware of the fact that the best work can be done with either dry feed or with the addition of water, but exceedingly good screening has been accomplished on damp material, illustrating that vibrating screens are very suitable for this class of work.

The area of the screening surface varies with different designs and also the number of decks possible. Some are limited to one deck only, while others may have one, two or three screening surfaces.

As regards capacity it is well to remember what is meant by a certain rated capacity of tons per hour. Does it mean the total feed to the screen or the product passing through the screen openings. With a single deck screen the feed may be 50 tons per hour and the over size 20 tons and the material passing through the screen openings 30 tons per hour. There is a vast difference between rating this screen at 50 or 30 tons per hour.

The efficiency of a screen is, of course, dependent on the amount of material remaining with the oversize that is not too large in size to have passed through the screen openings.

The screening surface is usually made of wire cloth, with only a few of the vibrating screens is it possible to use perforated plate. If it is desired to obtain a product of $\frac{1}{4}$ -in. ring size, the question will arise as to what opening will be required in the screen cloth. Owing to the slope of the screening surface it naturally would be assumed that the

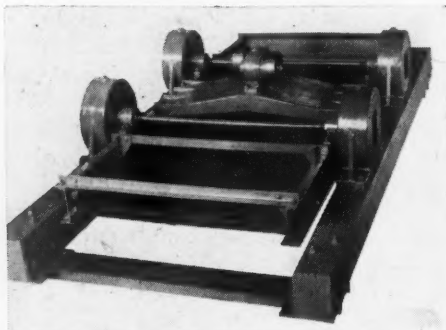


Fig. 14. A unique vibrator

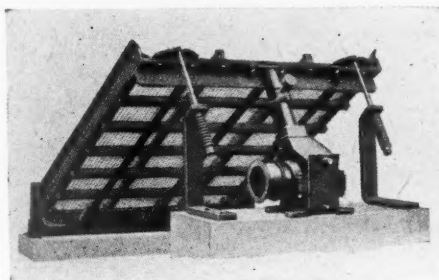


Fig. 17. Maximum vibration at feed end

opening should be a certain percentage larger than the ring size of product and this method is followed in most installations. By using the largest opening possible it follows that the maximum tonnage is obtained.

The Leahy screen as shown in Fig. No. 11 is manufactured by the Deister Concentrator Co. of Fort Wayne, Ind., and has a mechanical vibrator and screen cloth fastened at each end longitudinally, with a vibrating member extending transversely across the center of the screen surface. The maximum vibration of about $\frac{1}{16}$ -in. is thus confined to the center with diminishing vibrations toward the ends. The vibrator consists of a cam arrangement, having eight teeth; thus when the vibrator is driven at 200 r.p.m. there are 1600 vibrations transferred to the screen cloth per minute. The angle of slope is recommended from 28 to 35 deg., and the screen is built in two sizes, 3 ft. by 5 ft. and 3 ft. by 6 ft., requiring about $\frac{1}{2}$ h.p. to operate. Capacities are listed from 7 to 30 tons per hour of undersize product, 20 mesh to $\frac{3}{4}$ -in. mesh.

The W. S. Tyler Co. of Cleveland, Ohio, are manufacturers of the Hum-mer electric

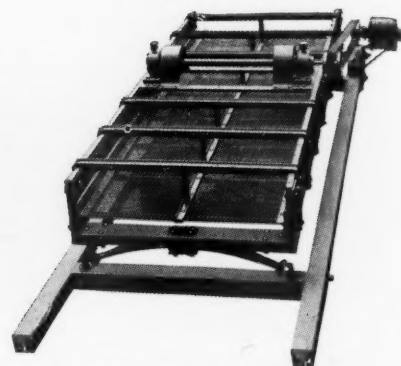


Fig. 15. Entire frame vibrates

vibrating screen. The screen cloth is stretched across the surface transversely and a bar through the center longitudinally attached to an electric magnet above provides the vibratory action. The maximum vibration is thus delivered at the center longitudinally and diminishes toward the sides. Fig. No. 12 illustrates a double unit screen. Each unit is made in widths, 3 ft. or 4 ft. wide and with one, two or three surfaces. The vibrator consists of a magnet and armature and is operated by the alterations of current supplied by a 15-cycle current generator. Angle of slope is given as 28' to 35 deg.

Another electrically operated vibrating screen (Fig. No. 13) is the Mitchell type as made by the C. W. Hunt Co., Inc., New York. A motor built in the vibrating mechanism revolves at high speed a ball at each end, these balls being placed 180 deg. apart, and the result is a sidewise upward and downward circular motion. The standard screen size is 3 ft. wide by 5 ft. long.

A unique mechanically operated vibratory screen (Fig. 14) is manufactured by the Galland-Henning Manufacturing Co. of Milwaukee, Wis. It consists of a steel screen box to which the self-contained screen frames are attached and has a vibrator fitted to the top which gives a vibratory motion of any desired intensity and in any desired angle to the screen surface, the double unbalanced pulley arrangement giving a motion in one direction only. The screen box is supported by a device fitted with rubber bumpers to give intensity to the vibration and absorb any vibration that might be transferred to the support frame. These supports are adjustable for direction of vi-

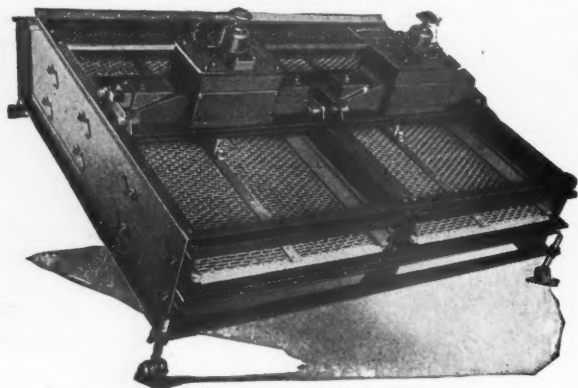


Fig. 12. Screen vibrated by electro-magnet

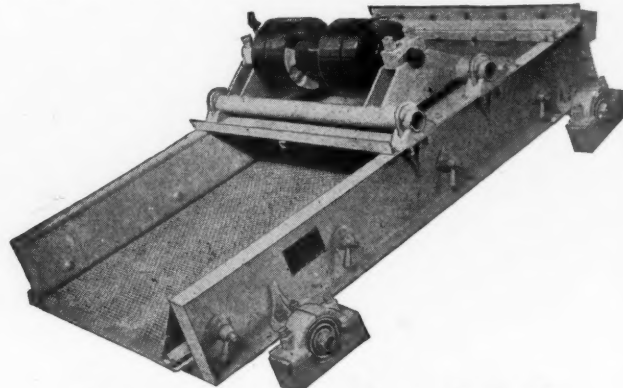


Fig. 16. Screen vibrated by weighted pulley

brating motion. The standard sizes are 3 ft. or 4 ft. wide and 8 ft. to 10 ft. long and the usual angle of slope is from 20 to 35 deg. with single, double or triple screening surfaces of the open or enclosed types and requires about 1 h.p. to operate.

With the type of screen as shown in Fig. No. 15 the entire upper screen frame to which the screen cloth is fastened vibrates. The Universal Vibrating Screen Co. of Racine, Wis., manufactures this design of mechanically operated vibrating

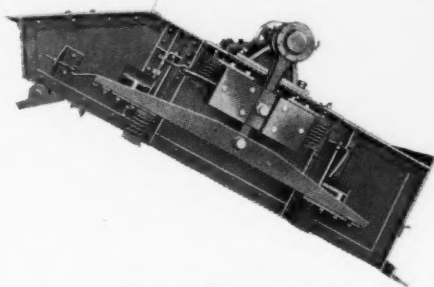


Fig. 19. Frame floats on coil springs

screen. Two off center weights mounted on a shaft rotating at 1800 r.p.m. and supported by bearings fastened to the upper frame provide a vibratory movement of about $\frac{1}{8}$ in. extent. The upper frame is supported from the lower frame by a spring at each end. Both frames are made of wood, the upper being reinforced with steel. A 1 h.p. motor fastened to the lower frame is belted to the vibrator shaft. These screens are built with a single deck only and the standard size is 3 ft. wide by 8 ft. long. For a product of $\frac{1}{4}$ in. to dust a slope of 42 deg. is recommended for the 1 in. to $1\frac{3}{4}$ in. product a slope of 30 deg.

Fig. No. 16 illustrates the type of vibrating screen as produced by the Link-Belt Co. of Chicago. It is made with one, two or three screening surfaces in four standard sizes, 3 ft. by 5 ft., 3 ft. by 8 ft., 4 ft. by 5 ft. and 4 ft. by 8 ft. The vibrator is a mechanical device consisting of a pulley with counter-weights attached rotating at high speed on a stationary shaft attached

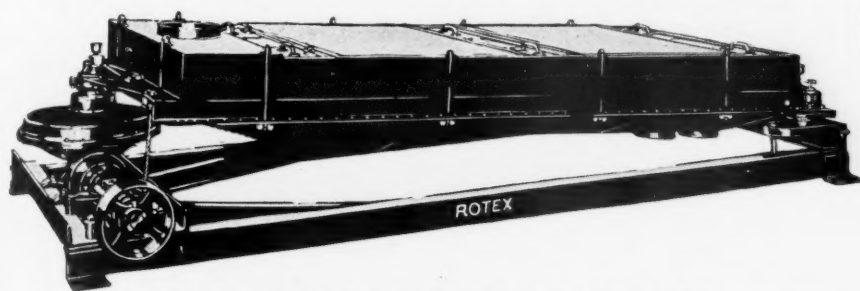


Fig. 21. Gyrate and vibrated with rubber balls

to the screen box to which is fastened the screen cloth. The screen box is made of steel and mounted on four flat spiral springs. The result is a screen with an unobstructed surface and vibrating the entire area with a circular action.

Fig. No. 17 illustrates the Moto-Vibro screen that is built in single, double or triple units by the Sturtevant Mill Co. of Boston, Mass., each unit with one, two or three



Fig. 18. Vibrated by hammers

screening surfaces. The vibration is of the eccentric type with a small throw operating at 1800 r.p.m. placed beneath the screen and transmitting the vibration to the screen

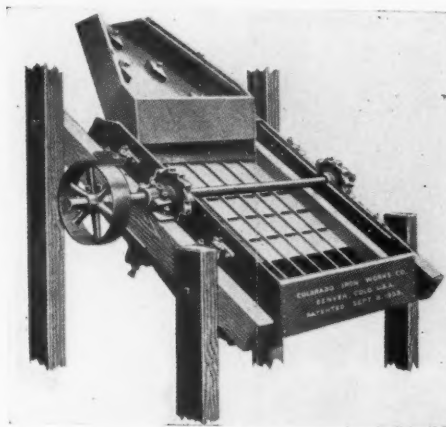


Fig. 22. Vibrated by impact

frames near the upper end, which gives the maximum vibration at the feed end with diminishing vibrations as the lower end of the screen is reached. The vibrator may be belted direct to a motor or to any other source of power, requiring about 1 h.p. to

The surface is divided into three sections lengthwise. Each section consists of a frame to which the screen cloth is tacked. Hammer bars actuated by cams transmit the blows to the screen frames. The cams are of the double type and the shaft runs at 120 r.p.m. The usual angle of slope is about 50 deg. and 1 h.p. is required to operate it.

An eccentric type of vibratory screen was developed by the Pittsburgh Coal Washer

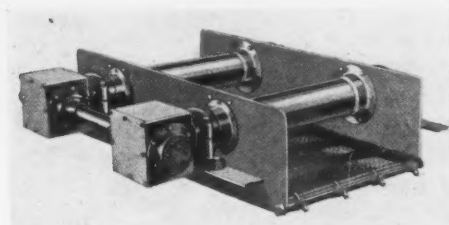


Fig. 20. Vibrated with two eccentrics

Co. of Pittsburgh, Pa., as shown in Fig. 19. The frames to which the screen cloth is attached are vibrated by eccentrics placed above and are also supported by coil springs on the sides which are intended to float the frame with load. The eccentric shaft has a pulley attached for belting to motor. These screens are furnished with a single eccentric shaft as shown or two in a random arrangement with single, double or triple decks.

Another eccentric type of vibrating screen is shown in Fig. 20 and manufactured by the Simplicity Engineering Co. of Durand, Mich. The screen box is suspended from eccentrics which gives an oscillating motion to the screen surface. The driving arrangement on one side consists of a shaft coupled direct to a motor and drives the two eccentric shafts by means of gears. It is made with a single deck, having 18 sq. ft. of surface.

The Rotex screen (Fig. No. 21) is not a vibrating type as the term is generally accepted. The Orville Simpson Co. of Cincinnati, O., have built screens or sifters for other purposes and applied the design as shown in the illustration to the stone industry. This is a single deck screen with a 3 ft. by 7 ft. surface setting nearly level with a gyratory motion in a horizontal plane applied at one end while the other end is pivoted. Rubber balls confined beneath the screen are deflected upward due to the motion and strike against the under side of the screen. This action causes the vibration of the screen cloth. From 1 to 4 h.p. is required to operate this screen.

The Colorado Iron Works Co. of Denver, Colo., have for many years made the Impact screen as shown in Fig. 22 for the metal mining industry. The entire frame is mounted on elliptical springs which force it upward against stops. A ratchet or cam arrangement on a rotating shaft forces the frame downward against the springs and when released is carried upward against the stops. Two standard sizes, one 3 ft. by 3 ft. and the other 3 ft. by 4 ft. with single deck are offered.

Gravel Company Works Its Bank Like a Quarry Face

Ball-Benton Sand and Gravel Company, of Benton, Ark.,
Has Successfully Introduced New Methods of Operation

THE Ball-Benton Gravel Co. operates the largest sand and gravel plant in Arkansas at Benton, which is near Hot Springs. It is not only the largest producer in the state but it is one of the large producers in the country, in the class of those plants which have a capacity for more than 5000 tons per day. The day before the plant was visited by a ROCK PRODUCTS editor recently, shipments were 75 cars of washed and screened material for aggregate and similar uses and 35 cars of washed gravel ballast.

Washed ballast forms an important proportion of the production of this plant and

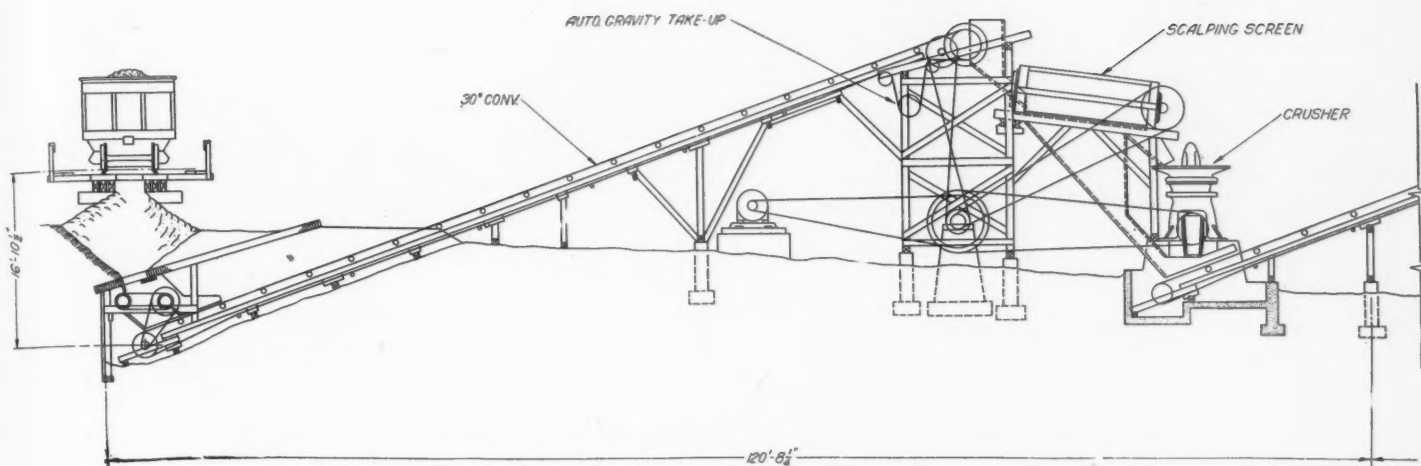
one which has been studied and made as a specialty. Mr. Ball, the president of the company, was for years a railroad man in charge of maintenance of way, and he has very definite ideas as to how washed ballast should be made. The specifications permit the inclusion of as much as 30% of sand, and the company has sand in excess. But ballast goes out more often with 15 to 20% sand than the permitted 30%. The variation of the sizes of gravel coarser than sand are taken into account and a mixture made that experience has shown to have the proper ballast characteristics. Naturally such a

product is much in demand and shipments are made to long distances from the plant, in some cases as much as 300 miles. An ingenious system of chutes and by-passes permits any mixture of sand and gravel to be made as desired.

To the producer, however, the most interesting feature of this operation is not the washing and screening process but the way the gravel is taken from the bank. It is one of a few places in the United States where a gravel bank is drilled and shot as if it were a quarry face. The reason for this unusual practice comes, of course, from



The screening and washing plant of the Ball-Benton Gravel Co., where the "quarried" sand and gravel is prepared for the market



Section through the field hopper and crushing and scalping plant

the solidified nature of the deposit.

The deposit is slightly cemented, but it is not a "hard pan." It can be dug from the bank with the steam shovel and, as the cementation breaks up in passing through the washing plant, it would seem that there would be no need of drilling and blasting. But experience has shown that the blasting method is actually cheaper and results in larger tonnages. For one thing, digging the gravel without blasting wears out a set of expensive manganese steel dipper teeth in three days, and digging in the blasted ground a set of teeth will last a year. For another the material is not lumpy after it is shot and it goes to the washing plant in a condition that is much easier to handle.

Stripping is a real problem at this plant. The gravel is everywhere about 35 ft. thick, but there is a red earth overburden that may be anything from 6 to 25 ft. thick. Often moving such an overburden would be dodged by a producer as being unprofitable.

But at this pit the ground is worked systematically and continuously and a stripping method has been worked out which permits all the bank to be commercially profitable.

In working the bank, in new ground, a cut is made through the overburden by a steam shovel casting the dirt to one side. A second steam shovel follows and removes the gravel so stripped, which is sent to the plant. Before all the gravel is taken out the stripping shovel has been moved back and begun a new cut through the overburden casting the dirt into the cut between the steam shovel track and the bank which was made by removing the ground. When the shovel below has taken out the gravel to the end of the cut it comes back on its own track, side casting the dirt that has been thrown down by the stripping shovel, leaving the bank clean. It then goes into the stripped ground with new tracks for itself and the cars behind the stripping shovel and

repeats the work of the first cut, coming back on its own track and side casting the dirt away from the bank on its return.

To handle the stripping twice in this way seems expensive, but it is the method that experience has shown to be the cheapest



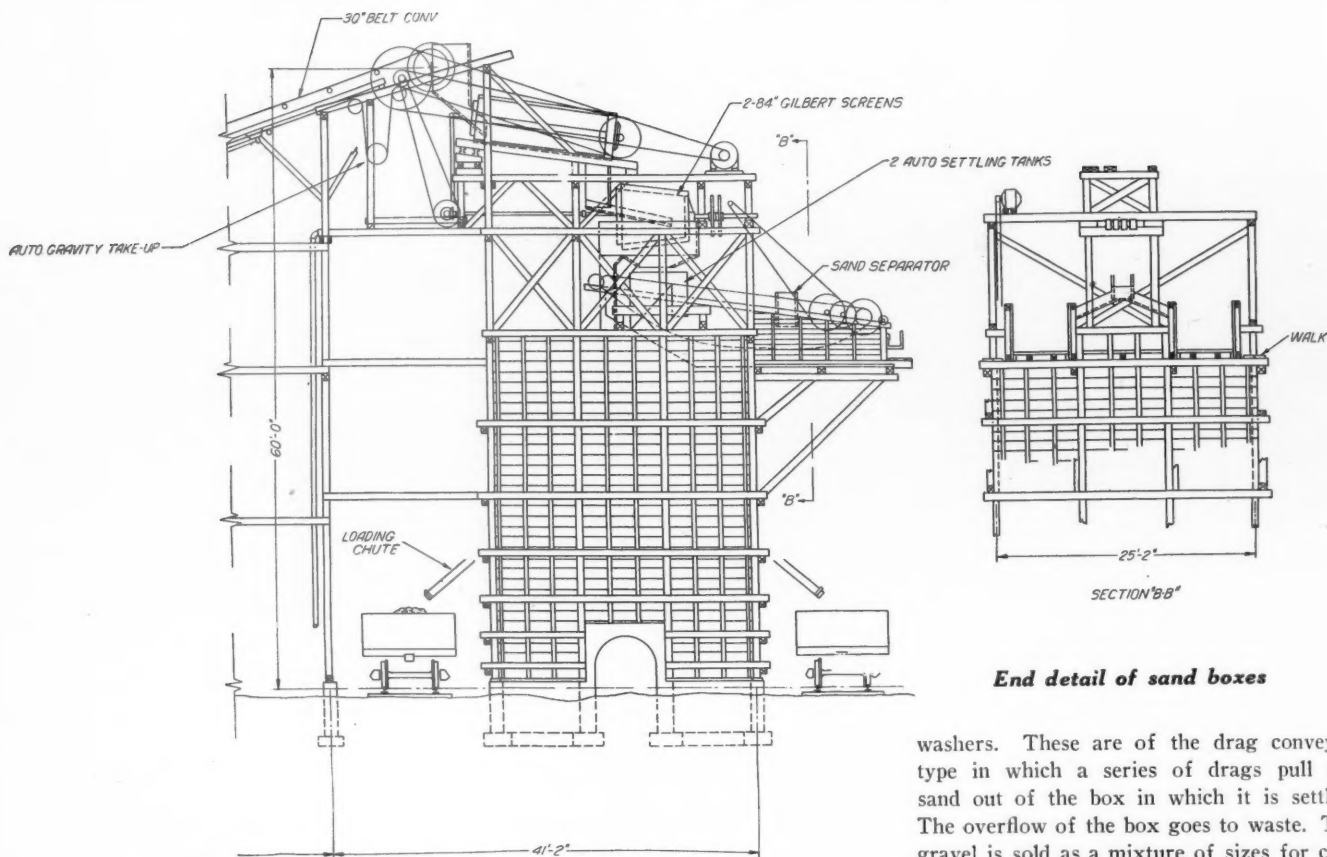
Drilling the gravel bank



The shovel above casts the strippings into the pit. These are removed by a shovel on the track below when it returns after digging the gravel

under the conditions. It may be modified, however, in the future, as it is expected to install shovels of the full revolving type with long booms, such as have been developed for stripping open-cut coal mines. By using these long boom shovels it will be possible to cast the strippings far enough to one side so that they will clear the shovel tracks altogether. This will eliminate the work of the gravel shovel side casting the strippings to get them away from the face.

In drilling and blasting the bank, holes are put down 30 ft. back from the face and 30 ft. apart. This is a wider spacing than is usually found in quarry practice. A charge of 150 lb. of 40% Hercules dynamite is



Showing how the scrubber, screens, and sand boxes are mounted above the bins

End detail of sand boxes

placed in each hole. Black powder would do the work and be cheaper, but it cannot often be used on account of the seepage water in the bank. Sometimes it is used in the dry time of the year when the holes show dry to the bottom.

When the holes are shot the bank hardly moves, but the effect is to loosen the material so that it can be dug easily and so that there will be no large pieces.

The bank run is loaded into Western side dump cars and hauled to the plant hopper which is below the level of the ground. A feeder of the apron type feeds it from the hopper to a 30-in. belt conveyor with 100 ft. centers, which discharges into the scalping screen. Everything over 2½ in. falls from the screen to a No. 5 Austin gyratory crusher. The undersize of the screen goes by a chute to a 30-in. conveyor 306 ft. long, which also takes the crusher discharge, so that everything goes into a cylindrical scrubber mounted on the bins. The discharge of the conveyor is 60 ft. above the ground.

The scrubber is 14 ft. long and 4 ft. in diameter and it is provided with lifters to turn the gravel and baffles to hold a sufficient body of material in it so that the pebbles will scrub on one another as they pass through. The scrubber has been found to give an efficient preparation for the further washing and screening which the material gets in the two 84-in. Gilbert screens into which the scrubber discharges.

There are two of these screens and they

are provided with the usual washing pipes by which a stream of water is kept playing upon the gravel as it rolls, thus loosening any dirt which may still adhere to the pebbles and giving everything a thorough rinsing.

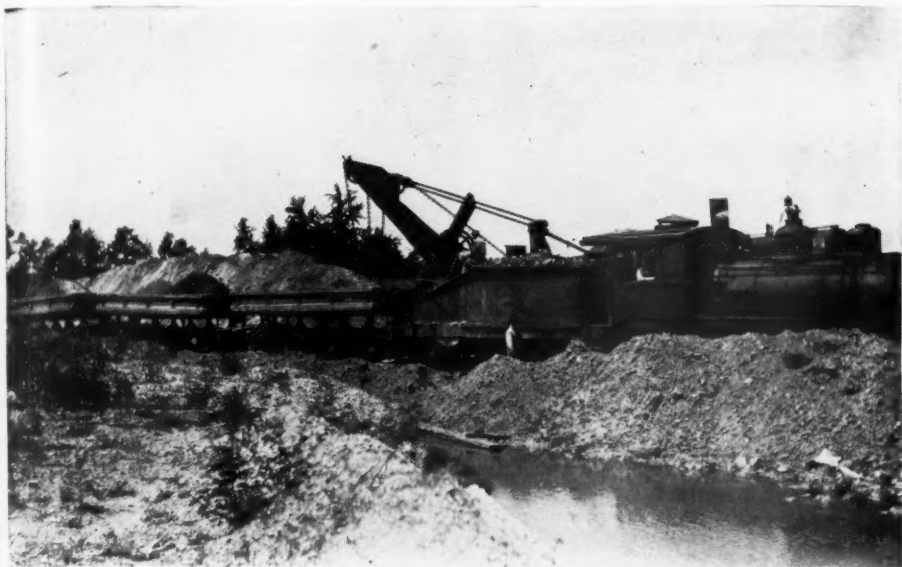
The screens separate gravel from sand. The gravel goes to bins and the sand with the water which accompanies it goes to sand

washers. These are of the drag conveyor type in which a series of drags pull the sand out of the box in which it is settled. The overflow of the box goes to waste. The gravel is sold as a mixture of sizes for concrete aggregate and like purposes. When it is to be sold as washed ballast it is mixed with the right amount of sand by special chutes.

Water for washing comes from the Saline river, which is two miles away from the plant. A pumping plant is maintained there which contains a 6-in. Allis-Chalmers centrifugal pump direct connected to a motor of the same make. The pipe line is 10 in. in diameter and this large size was put in to lower the friction head against which the



The shovel below digs the 35-ft. bank of gravel and side casts the strippings on its return. Note the heavy overburden at the right of the picture

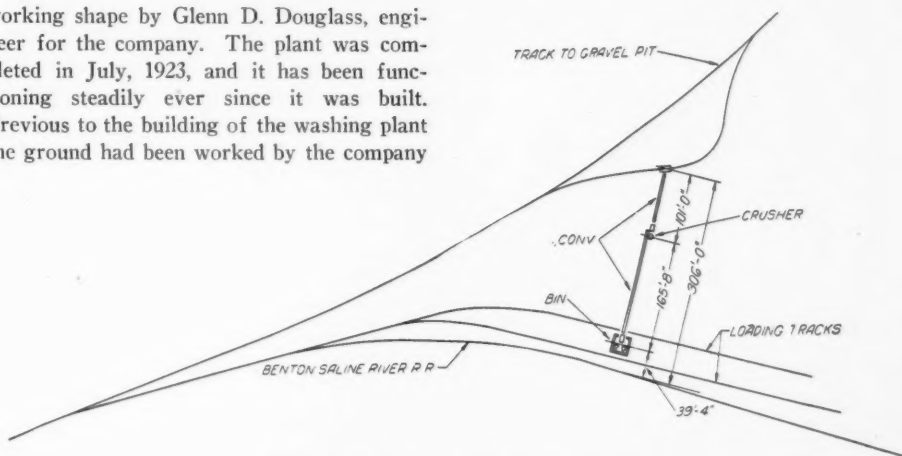


A gravel train being loaded at the bank

pump must work. This 10 in. pipe is of cast iron, which is somewhat unusual in an installation of this kind. An auxiliary plant is maintained on Depot creek, about 700 ft. from the plant, and a pump installed in the creek near the plant furnishes water during the season of heavy rains.

The deposit which is worked by the company covers 400 acres. After it had been acquired by the present owners a series of tests was undertaken to prove the possibility of working it commercially and washing it to a marketable product. In this work the president and vice-president of the company visited almost every large gravel washing plant in the country. From the data thus obtained, both by tests and observations, the ideas of the present plant were put into

working shape by Glenn D. Douglass, engineer for the company. The plant was completed in July, 1923, and it has been functioning steadily ever since it was built. Previous to the building of the washing plant the ground had been worked by the company



Plan of the plant and track system



The waste flume crosses the main line of the railroad

(which was founded in 1917) for road gravel.

Benton is about half way between Hot Springs and Little Rock. It lies near the edge of the coastal plain or "delta country" of Arkansas and the gravel is said by Dr. Branner, the state geologist, to belong to the Tertiary gravels. The pebbles are almost all of quartz and while they are somewhat worn, they have not the well rounded appearance of most glacial and stream gravels. The deposit which is worked at Benton is by no means the only gravel land in the region, but it is perhaps the most accessible.

The machinery except as otherwise mentioned was supplied by the Stephens-Adamson Manufacturing Co. of Aurora, Ill.

The principal office of the company is in the Home Insurance building, Little Rock, Ark. John J. Ball is president of the company, W. D. Carmack is vice-president and Chas. M. King is secretary-treasurer.

Court Rules Limestone Other Than Building Stone Is a Mineral

THE decision of Judge Tillman D. Johnson in the case of the Dunbar Lime Co. against the Utah-Idaho Sugar Co., in which the court ruled that limestone used for other than building purposes is a mineral under the meaning of decisions of the higher federal courts, and that therefore school lands containing such stone never passed to the state under the enabling act, is to be appealed to the circuit court of appeals. [The details in connection with this controversy were published in ROCK PRODUCTS, November 14 issue. The matter is of general importance because it may have a bearing on the question of taxing materials.]

Mahlon E. Wilson, counsel for the lime company against which the suit was decided, pointed out that if the higher courts hold with the local court in this case, it will open the way for including practically all other minerals in this classification and the state will consequently lose more of its valuable school sections.—Salt Lake City (Utah) Tribune.

Cost Finding and Its Problems in the Sand, Gravel and Quarry Industries

VI—Overhead, Collection and Distribution

By Alfred Baruch

Consulting Industrial Engineer, New York City

THE OPERATOR is rapidly discovering that overhead cannot be ignored or treated lightly. As a matter of fact, it will soon become apparent that intelligent and scientific estimating is largely concerned with the collection, classification, and proper distribution of overhead.

The Classification of Overhead

In order to bring about this scientific distribution of overhead it will be found necessary to separate the indirect expenses into two groups:

- (1) The selling and administrative expense or office cost, as it is sometimes known;
- (2) The plant expense.

An indication of what might constitute the administrative and selling expense was given in an earlier article when the expense order numbers were issued. It is customary to maintain separate records and make separate charges for the administrative and for the selling expense. But since selling expense is not as important an item in this field as it is in others, no separate records are kept. The two sets of expenses are lumped in one. However, it is very important to separate the selling and administrative expenses from the plant indirect expense since the former is applied as a percentage of the total plant operating cost; while the latter is applied in a totally different manner as will be seen later.

Administrative and Selling Expenses

In considering the make-up of the administrative and selling expenses it is almost inevitable that we should start with the executive salaries. The president and other officials of the company, or the plant owner if one man only owns the business, must assign to themselves such salaries as they think they would be able to command in a similar position while working for someone else.

Having disposed of the executive salaries, it is necessary to consider the case of the salesmen if any are employed. Some sand and gravel men pay their salesmen salaries while others prefer the commission basis. The latter would seem the less desirable from many points of view.

Getting sand and gravel orders is somewhat different from ordinary selling. It is true that results depend, to a certain extent, on the salesman's ability and willingness to

"hustle." But largely, getting business depends on a thorough knowledge of the costs and such efficient plant management that the price and the quality of the sand compares favorably with those of any competitor. Consequently, it is advisable to pay the salesman a salary because he is not a salesman but rather an engineer. If he works on commission he might be tempted to shave the figures so closely that the plant owner will

suffer a loss instead of obtaining a profit.

The salaries of the bookkeeper, stenographer, or other clerks employed must be included in the list of selling and administrative expense. Where the plant is large, a part of this expense may be apportioned to plant overhead. But as a rule it is charged to the office.

Office supplies are another charge to this group. Stamps, pencils, erasers and any other office supplies not specifically provided for elsewhere come under this heading.

Should it be found convenient to maintain an automobile for the use of the salesman while going around from builder to builder, that expense must be charged to the office. Any other expenses incurred while making an effort to obtain orders would be handled in a similar way.

Advertising must also be included among the office expenses. This would cover any form of it, whether it is newspaper and magazine announcements, circulars, or souvenirs.

In case the plant owner decides to pay his salesman on a commission basis, he should charge all such expenditures to office expense. Of course, if the orders are big enough it is possible to charge the commission directly. Membership fees paid to trade associations make up a part of the office expense.

Printing and stationery, telephone, charities and miscellaneous expenses close the list of the selling and administrative overhead charges. And those items subsequently listed as plant operation expenses represent that part of the cost which cannot be charged directly, but which must be carefully analyzed so as to distribute its share to each lot of material excavated.

Indirect Expense of Plant Operation

In considering the plant indirect expense, the salary of the foreman would be the first to be examined. It is the foreman's duty to assign, supervise and inspect the work. As his duties cannot be defined so minutely as to enable him to spend a certain amount of time on each operation and then have his work charged to that operation, it is necessary to charge the foreman's time to overhead and to allocate a certain portion of this to every operation.

Plant clerks, time keepers, store keepers and any other men who do clerical work in

Outline of Articles

THESE articles describe a system designed especially for the rock products industries and are elaborated by descriptions of the use of each part of the system with examples of the forms and records that must be maintained.

ARTICLES ALREADY PUBLISHED

No. 1. Introduction. (The meaning of costs, the uses of a cost system, the advantages of uniform cost methods in a competitive group, and definitions of cost terms.)—June 16, 1923.

No. 2. Classification of Materials and Expenditures. (A system of symbol identification of materials and expenses that make the distribution of costs automatic.)—June 30, 1923.

No. 3. Estimates and Orders. (The use of an estimate sheet and the control of production through the proper routing and follow-up of orders.)—July 14, 1923.

No. 4. Material Charges—August 11 and September 8, 1923.

No. 5. Labor Records—October 17, 1925.

No. 6. Overhead, Collection and Distribution—This issue.

ARTICLES TO BE PUBLISHED

No. 7. Proper Application of Burden Charges.

No. 8. Cost Reconciliation and Monthly Reports.

No. 9. A Hypothetical Case of Cost Operation in the Rock Products Industry.

the plant itself should have their time charged to the indirect expense. The small plants usually have no such expense.

Another item on this list is that of general or non-productive labor. Although this heading in itself is subject to several classifications, it is necessary to lump non-productive labor in one group. This is largely to be made up of helpers in the plant who do not work at regular tasks but are employed to keep the machinery clean and in repair, and to do any of the odds and ends that the plant requires. It is also necessary that the plant be charged with all the idle time incurred by productive workers who are paid daily wages. For example, the men may finish working one bank at 4 o'clock. It may not be advisable to send them to another bank for less than an hour. In that case the plant would have to pay the men for this idle hour.

Building and Equipment Charges

If the owner owns the building which houses his wet screens and he makes repairs on them that cannot be considered as adding to their life but merely as keeping them in a safe and good condition, this expense should naturally be included in the overhead.

The next item to consider is that of machinery. Any repairs to the machinery that do not for all practical purposes make the machines new again must be included in the list of plant expense. The same would apply to the replacement of non-durable tools and repairs to any of the other equipment.

Any repairs to the machines such as replacing belts, realigning shafts, etc., must be taken into account when the list of expenses is made up.

The cost of printing time cards, expense slips, cost records and all other documents used in the plant must be charged to expense. This item should not be confused with a corresponding one in office expenses. There only the commercial forms and documents are accounted for.

Electric current must be charged to indirect expense. This is the current that is used for lighting and for power. Coal used for heating should also be included. The cost of gasoline for driving the trucks or for driving any engine must not be forgotten. Maintenance of the trucks and garage, salary of the drivers and other incidental expenses are all parts of the indirect expense that must be accounted for.

Rent, Interest, Depreciation and Insurance

The above covers the items of indirect expense about which there have never been any question. However, there are some charges also a part of the overhead which have been the subject of debate among plant owners and cost experts.

The first of these is depreciation. Many plant owners ignore the items of depreciation altogether. When they do include it, they usually make an arbitrary charge without considering the purpose of a depreciation

fund at all. Depreciation is charged in recognition of the fact that in addition to the ordinary accidents that may happen to any mechanical device, which damages can be repaired when they occur, there is a reasonable wear and tear on the machine and the equipment that cannot be replaced by repairs of any sort. Consequently, a fund must be provided which will be available for the purchase of new machines when the present ones wear out or are no longer usable.

In addition to the actual wear and tear, there is obsolescence to be considered. Occasionally machines become impractical because newer and more efficient tools are put on the market. In such a case it would not be advisable to go on using the old machines when in competition with men who are using the new ones.

The amount of depreciation to charge each year depends on the type of the machine or other equipment under consideration, their condition at the time bought, the character of the usage that they are likely to get, the existence of external conditions that make for quick deterioration or for long life, etc.

When a machine is bought second hand, care should be taken in determining the exact amount of usage it has already received so as to be able to estimate its remaining life. This information should be made one of the conditions of the purchase, since a machine that has had hard usage, even if it appears all right, is quite likely to go to pieces at any time.

Repairs Not Depreciation Charge

A good deal of confusion exists in the minds of some operators as to the distinction between the repairs and charges for depreciation. Some men believe that if repairs are made and if they are charged to the cost, no depreciation charge should be made. But the two charges are quite different in their character. Depreciation is a reserve against the time when equipment will be useless and will have to be replaced. Repairs usually follow a damage.

It is naturally important to decide with great accuracy just what constitutes improvements to the equipment and, consequently an increase in the assets, and what is merely repair work that forms a charge against the revenue.

Repairs are not improvements in the ordinary sense. Repairs merely replace broken parts and keep the equipment in condition to be used. Improvements enhance the value of the equipment and the machinery. They are additions to the capital investment and not a charge against the revenue of the business.

The cost of non-durable equipment is not to be added to the assets. This cost is a charge against the revenue and must be included in the overhead. All equipment, machinery and buildings should be insured. The cost of this insurance forms part of the overhead of the plant. The insurance premiums should be divided by 12 and 1-12 should be charged off each month so that

monthly comparisons can be made properly. Liability and compensation insurance should be charged to overhead as well.

The Rent Concept

Rent is another debated question. To nearly everyone it is apparent that rent itself should be charged into overhead. But when we come to consider the case of a man who owns his buildings we find a wide difference of opinion. Some think that such a man should charge himself rent and others do not.

Suppose this man has to borrow money to buy the building which holds his plant. He would certainly have to pay interest on the money. This interest should come out of the overhead since it is just as much a part of the cost as the rent is, in the case of the man who does not own his building. But then, if a man may charge interest on his building investment, why not charge interest on his equipment investment and his money tied up in stock. These charges must be taken into account if the overhead is to represent the true cost.

Difficulties in Applying Overhead

The problem in cost finding is to charge each operation with the cost it incurs. With a little effort this is an easy thing to do in case of prime costs. But charging the proper amount of indirect cost to each operation is much more difficult.

If the overhead were constant at all times of the year it would be an easy matter to apportion a fixed charge to all operations so that each one would contribute its share of the expense. Then the only problem would be to adjust the rate to the volume of business as the latter changes and an adequate return would be insured.

But the overhead is not fixed. It varies with the volume of business. It also varies with the season and with the nature of the individual components of overhead itself.

The Fixed Indirect Expense

Of course there are some items that are more or less constant. On examining the chart of overhead items it will be seen at once that the salary of the executive must go on at all times. They are a part of the business and this item would not vary unless their salaries were cut or raised as the business warranted the change.

Clerical salaries, office supplies, association dues, printing and stationery and telephone charges are likely to remain constant. Traveling expenses, advertising, commissions and similar expenditures vary with business conditions.

In the case of plant expenses, the lines of cleavage between the fixed and the variable charges are more distinct. There, rent, light, power, repairs, insurance, maintenance charges and the salaries of the foremen have to be paid regularly regardless of the condition of business. Repair charges usually follow the damage so that cost is unavoidable. Depreciation also goes on regardless of the volume of business, except that ma-

chinery depreciates more rapidly when it is idle than when it is in constant use. The drivers work by the week and there is usually just enough work around to make it impossible to lay them off.

General or non-productive labor will decrease when the business volume drops except in plants that make a practice of keeping together an organization once it reaches the point of efficiency the plant owner wants. Gasoline, traveling expenses and printing will change in proportion to the business done.

Change in Rate

Owing to the fact that some expenses are fixed and do not change in spite of a decreased volume of business, it is natural that the ratio between overhead and direct labor should change as the volume of business changes. When there is a lot of work, the overhead rate drops in spite of some increasing expense. The rate will increase when work is scarce in spite of some decreasing expenses. The constant element in the overhead serves to lower the rate when orders are plenty and to raise the rate when they are scarce.

The purpose of distributing overhead to the various operations so carefully is two-

fold: (1) to see that this expenditure comes back in the form of revenue; (2) to see that each operation bears its share of the expense.

There has been no method of distribution devised, however, that will charge to each operation the exact amount of overhead expense that it incurs. For that reason it is best to strike an average and to distribute the expense on the basis of this average. The various methods of averaging expenses together with their respective advantages and disadvantages will be discussed in another article.

Monthly Comparisons

In order to keep overhead expenses within proper control, it is necessary to compare them with previous reports of expense. Some men prefer to compare each report with that of the previous month on the theory that, provided expenses are normal, there is not enough variation from one month to the next to justify a great disparity between corresponding items of the two months. Others prefer to compare a month with the same month the year previous. This would seem the better way for sand and gravel operators and for quarrymen. Production is seasonal and overhead is affected accordingly.

A German Slant on Evidences of American Prosperity

ONE of our German contemporaries (*Tonindustrie-Zeitung*) has been so much impressed with our story of the Peerless Portland Cement Co.'s plant at Detroit, published in the September 5, 1925, issue of *Rock Products*, that it has devoted considerable space to it, beginning as follows:

"In Germany as a consequence of the lost World War, and the inflation period following, there has been a great lack of money. So to find new and great developments in the cement and other industries, we must look to other nations who are richer, and in particular, the United States, which, at the present time is troubled with excess wealth. It is only necessary to observe the Peerless Portland Cement Co. story to bear out our contention. This story requires 17 pages and is profuse with illustrations and sketches, some of which, because we think they will be of great interest to our readers, we are reproducing here. It is only necessary to read our literal translation and study the accompanying illustrations to know that the boast 'Without a Peer' as applied to the Peerless Portland Cement Co.'s plant at Detroit, is not a vain one."

MONTHLY COMPARISON OF PLANT COSTS

ITEMS	Current Month	Average Month	Increase	Decrease
DEPARTMENTAL EXPENSES				
Stripping				
Excavating and Transferring				
Washing and Hoisting				
Loading Washed Material				
Loading Screened Sand				
GENERAL EXPENSES				
Total Plant Burden				
Direct Labor Cost (Payroll)				
Material Purchased This Month (Purchase Book)				
Plus Inventory at First of Month (Stock Record)				
TOTAL				
Less Inventory at End of Month (Stock Record)				
Net Shop Cost for Month				
Selling and Administrative Expenses				
Total Selling and Administrative Expenses				
Total Shop Burden				
Predetermined Rate x Direct Labor Cost				
Over or Under Absorbed Burden				
Total Office Expense				
Predetermined Rate x Plant Cost				
Over or under Absorbed Office Expense				
Reconciliation of Plant Costs				
Net Plant Cost for Month				
Office Expense				
Total Cost for Month				
Total Sales for Month (Sales Book)				
Less Cost				
Manufacturing Profit for the Month				

Scientific Basis of the Lime Burning Process*

Part II—Factors Affecting the Decomposition of Limestone

By Dr. G. Keppeler

IN the first part of this article published in the April 3 issue, the desirability of kiln gas analysis was pointed out and excess air shown to be detrimental to the kiln efficiency. This part deals with the decomposition pressures and temperatures of calcium carbonate.

Effect of Temperature

The decomposition of calcium carbonate is not determined by any given temperature, as for example in the case of the fusion of a crystalline substance. It takes place through a wide temperature limit. The processes involved are best understood when known fundamentals are first established. The decomposition of calcium carbonate may best be compared with the evaporation of a liquid such as water, which is, of course, thoroughly understood, but to which reference will be had in this study. The reader is accordingly referred to the Fig. 4 in which certain effects are noted. There it is seen that there is an equilibrium between water in the liquid and water in the vapor condition, and that there is a like equilibrium between calcium carbonate and lime and carbon dioxide on the other hand. With a vapor or gas pressure at 25 deg. C. the condition shown to the left of the figure takes place, and this corresponds to a vapor at 700 deg. C. for the case of limestone. Then

right hand of the diagram shown below.

The knowledge of the decomposition pressure of calcium carbonate is of very great importance in the scientific conduction of the lime-burning process. It is, therefore, very much worth while mentioning that for the past 10 years a great number of investigations have been instituted for the purpose of measuring this pressure as accurately as possible. During the past few years methods of mensuration have become so refined that the newer investigations have corrected the observations made in previous ones. Inasmuch as there is always a certain amount of interest in the results of investigations, all the results obtained have been tabulated in concise form in a table given elsewhere in this article. Then again all the various figures are plotted in curve form as seen in Fig. 5, in which the temperatures are plotted as abscissae and the decomposition pressures to calcium carbonate at these temperatures as ordinates. It is evident from an examination both of the table and the curve that the older values are not as accurate in any way as the newer ones developed with improved methods of mensuration.

As far as practical operations are concerned, what is of particular importance is the temperature at which the decomposi-

tion takes place, for at this temperature the pressure, which causes the carbon dioxide gas to emerge from the limestone is so great that the air is moved aside in a certain sense by the gas itself.

Decomposition Temperatures of Calcium Carbonate

Now the question arises how it is possible for the carbon dioxide in the stream of gas from the lime kiln to disengage itself. We have seen that the lime kiln gases contain between 15 and 35% of carbon dioxide. In Table 2 as well as from Fig. 5 there may be obtained the concentration of carbon dioxide gas in the lime kiln gas which is in equilibrium with the limestone itself at various temperatures. It is found that at a temperature of 775 or 830 deg. C. the gas that is in equilibrium with the limestone contains from 15 to 35 per cent of carbon dioxide. This is accordingly the temperature range in which the limestone emits still further quantities of carbon dioxide gas into the lime kiln gas. In other words between these temperatures the limestone is decomposing. Thus the decomposition of the limestone takes place between the temperature of 775 and 830 deg. in all the lime kilns which operate on the counter-current principle.

It is also important to know the temperature at which after, or secondary, decomposition takes place in the kiln through the action of air streaming through the not completely burnt limestone, and at which point accordingly a further evolution of carbon dioxide will take place. It is assumed that for this purpose a 3% concentration of carbon dioxide is always necessary. Hence it follows that the lower limit in this case is 700 deg. C.

An investigation has been made to explain what takes place at a temperature of 900 and the results are shown in graphical form in Fig. 6. These results were obtained in a small electric furnace. The temperature was made to increase in a constant manner up to a point somewhat in excess of 900 deg. C. If no change in the system took place, then it would follow that the temperature would continue to increase in the same constant and regular manner, but there now takes place the decomposition of the limestone, which is a veritable boiling process, and a considerable amount of heat is required to effect it, just as in the case when water is heated to the boiling temperature and heat has to be supplied to take care of the latent heat of vaporization. The temperature can-

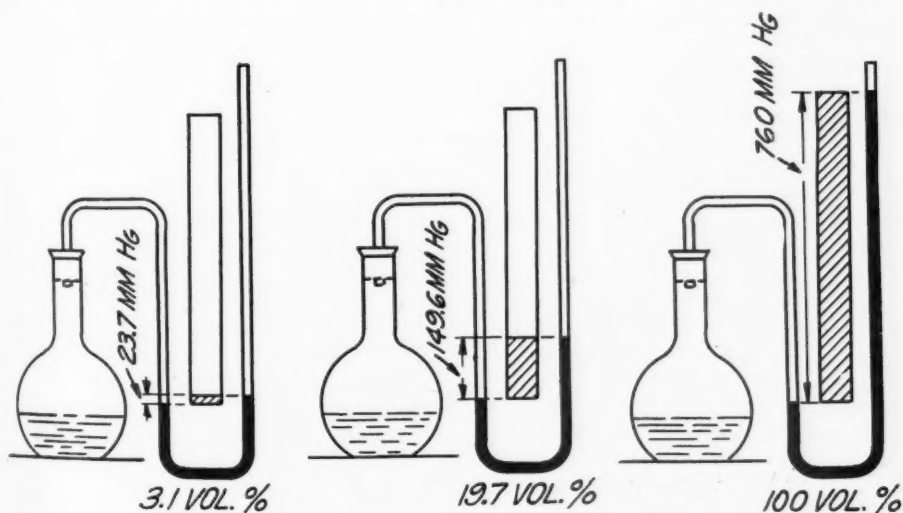


Fig. 4. Water vapor and decomposition pressures

again the middle condition occurs at with pressures at 60 and 795 deg. C., respectively, and the vapor or gas pressure at 100 and 900 deg. C. respectively, are shown at the

tion pressures to calcium carbonate becomes equal to one atmosphere. This takes place in the neighborhood of 900 deg. C. In other words the carbonate of lime at this temperature is a sort of boiling condition. Hence at this temperature it is no longer necessary to remove the evolved carbon dioxide with

*Translated by Universal Trade Press Syndicate from the Zeitschrift Angewandte Chemie, 1925 (397-405).

not rise any further until all of the limestone has been decomposed, and when this happens, the temperature rises still further and the curve that can be drawn for this phenomenon is then similar to the one that is obtained when the temperature of the furnace is increased and it does not contain limestone at all

The question arises what can be learned from this scientific explanation of the lime burning process that possesses actual practical value for the lime burner. In lime kilns of any sort whatsoever the charge is loaded into the apparatus at low temperatures and then is gradually heated up by means of a current of gas which is drawn through the hotter layer of material in the kiln. Our first study indicates to us that the carbon dioxide is evolved from the limestone at a temperature of 789 to 830 deg. C., but that the quantities of gas that are evolved at this temperature are but very small. When the temperature is raised and the point 900 deg. C. is reached, the point is reached where the evolution of carbon dioxide gas is no longer dependent on the existing conditions, such as the removal of the carbon dioxide as it is evolved from the surface of the limestone, but now the carbon dioxide stream that emerges from the limestone possesses sufficient power to push aside the air and evolve from the limestone.

Rate of Decomposition Proportional speed of heat transmission

But the last picture shows us that this evolution is dependent on the flow of heat to the limestone. The other layers of a piece of limestone, as soon as they are brought up to a temperature of 900 deg. C., yield their carbon dioxide content quite readily, due to the transmission of heat to them from the flame on the combustion gases. On the other hand the transmission of heat to the particles of limestone that lie deep under the

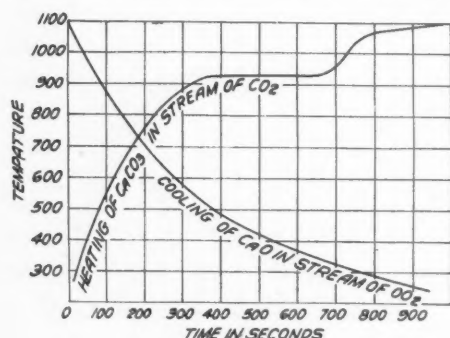


Fig. 6. Illustrating the check in heat absorption of limestone at about 900 deg. C.—the decomposition point

surface of the piece of carbonate depends on the rate at which heat is conducted by this material. Hence decomposition of the interior of the limestone takes place only so rapidly and to that measure in which heat is conducted from the

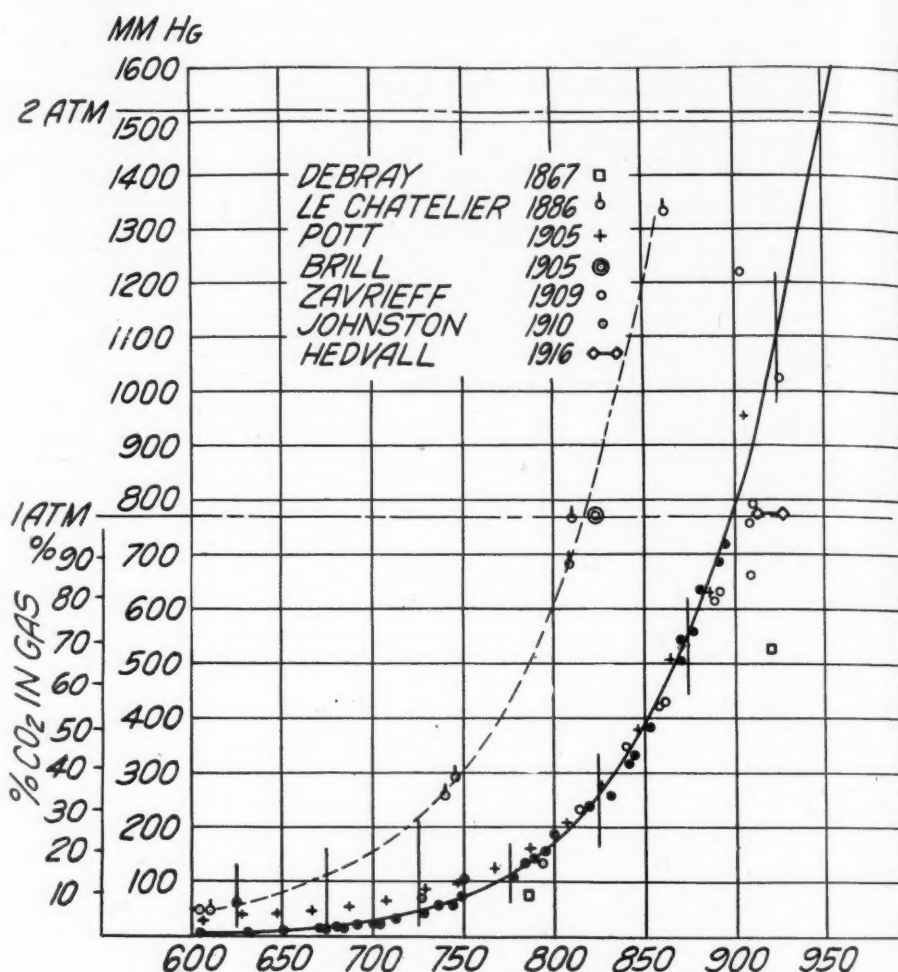


Fig. 5. Decomposition pressures of calcium carbonate at various temperatures in degrees centigrade

outside of the rock to the interior particles. The rate at which the heat is transmitted is greater, the higher the temperature in the neighborhood of the piece of limestone that is being burnt. Furthermore the rate of heat transmission depends as well on the heat conductivity of the layer of caustic lime which is formed over the burnt piece of limestone. But it is just on this point that we are very poorly informed and the establishment of the conditions under which these phenomena take place is one of the most difficult technical problems that can be conceived. However it is sufficient to say at this point that in each piece of limestone there are a series of zones set up according to the rate at which the temperature of 900 deg. C. is attained therein, corresponding to the speed of heat transmission, and in which decomposition of the limestone takes place.

Larger Sized Stone Requires Greater Heating

As has been said, the transmission of heat is greater, the higher the temperature at the surface of the limestone. If then the temperature over the charge is high, the flow of heat from the outside to the interior of the limestone will be

more rapid of its own account and a sort of cooling takes place. Thus it happens that for the most part the maximum temperature, which the limestone attains in the kiln, must lie between 1200 and 1300 deg. C. For reasons which will be discussed below the overheating of the limestone is also a condition which must be avoided in the practical operation of the kiln.

Then again, as far as the size of the pieces of limestone is concerned, it may be concluded from this study that the larger the pieces of rock, the greater the temperature differential must be between the inside and outside of the material, in order that a quick decomposition of the limestone ensue. This, in other words, simply means that the larger the pieces of limestone, the higher the temperature must be in excess of 900 deg. C. at the surface.

From the knowledge that is gained by a study of this decomposition pressure of calcium carbonate it may also be concluded that in the cooling zone of the kiln under practical operation, when the pieces of limestone no longer are present in the burning zone, the remainder of the undecomposed limestone must be further decomposed by the action of the stream of air that comes in contact with

it. The study of decomposition pressures which was made above shows that this process can ensue in practical lime burning up to the point where the temperature has become 700 deg. C. approximately. However it must be said that this after-burning, which is effected by means of the heat that is contained in the pieces of limestone themselves and with the aid of the air that comes in contact with them, is possible only at points which are but little removed from

bon dioxide disappears from the equilibrium and place is made for new carbon dioxide from the limestone. Thus at comparatively low temperatures the limestone can be thoroughly decomposed. In the same manner hydrogen reduces carbon dioxide to carbon monoxide and accelerates the rapidity of the decomposition of the limestone. These influences are more marked, the more thoroughly the organic substances are mixed with the carbonate.

TABLE I—MEASUREMENTS OF DECOMPOSITION PRESSURE OF CaCO_3

1867 Debray, Comptes rendus		1886 Le Chatelier, Comptes rendus		1905 Pott, Freiburg i. Br. S. 42 ((Values determined from curves)		1909 Zavrieff, Jour. Chim. phys.		1910 Johnston J. Am. Chem. Soc.	
Temp. deg. C.	CO ₂ pres- sure (*)	Temp. deg. C.	CO ₂ pres- sure	Temp. deg. C.	CO ₂ pres- sure	Temp. deg. C.	CO ₂ pres- sure	Temp. deg. C.	CO ₂ pres- sure
360						360	1.0		
450						445	8.5		
		547	27	547	30	525	18		
				587	34			587	1.0
		610	46	607	36			605	2.3
		625	56	627	38			631	4.0
				647	42			671	13.5
				667	48			673	14.5
				687	55			680	15.8
								682	16.7
								691	19.0
								701	23.0
								703	25.5
				707	65			711	32.7
				727	75	725	71	727	44
								736	54
		740	255					743	60
		745	289	747	95			748	70
						750	100	749	72
780	85			767	120			777	105
				787	155			786	134
								788	138
						793	170	795	150
		810	678	807	205			800	183
		812	763	827	270	815	230	819	235
								830	255
						840	342	840	311
				847	375			842	335
						860	420	852	381
		865	1333			870	500	857	420
								871	537
								876	557
				887	625			881	603
						890	610	883	629
						892	626	891	684
				907	950	910	755	894	716
						912	791.5		
920	520					926	1022		
				947	1850				
				967	2300				

(*) No trace of decomposition.

the burning zone in the limestone charge in the lime kiln, for the reason that cooling sets in very quickly.

Effects of Carbon and Other Reducing Agents

In the above there have been discussed the normal influences which control the practical lime-burning process. Now it remains to take into consideration the occasional factors that have some influence on the limestone decomposition. In the first place there is the question how do reducing agencies effect the process. This question may be answered in the following manner: The decomposition of the limestone is very considerably enhanced by the presence of reducing agents. For example, when the carbonate of lime is placed in contact with coal or carbon, then the carbon dioxide, which is evolved from the limestone, is reduced at temperature in excess of 800 deg. C. to carbon monoxide. In this manner the car-

The part played by carbon in the decomposition of barium carbonate is of much greater significance, for the decomposition pressure of the barium carbonate is less than that of calcium carbonate and for this reason higher temperatures are required with the former. The admixture of carbon is carried out at best at temperatures at which the equilibrium $\text{C} + \text{CO}_2 \rightleftharpoons 2\text{CO}$ lies preponderantly on the side of carbon monoxide, but at which the decomposition process of the barium carbonate is still too low to result in the decomposition of carbonate quickly and completely.

Steam an Aid to Lime Burning?

Another factor whose influence is always given very careful consideration in practical lime burning is the presence of water vapor. The exact nature of this influence has not been accurately defined. The experiments which were made by Herzfeld and which were very painstaking

TABLE II TABLE II—CO ₂ CONCENTRATION IN EQUILIBRIUM WITH CaCO_3 ACCORD- ING TO JOHNSTON'S VALUES		
Temperature deg. C.	CO ₂ pressure in mm. of mercury	CO ₂ concentration by vol. (pct.)
550	0.57	0.08
600	2.35	0.3
650	8.2	1.1
700	25.3	3.3
750	68	9.0
800	168	22.1
850	373	49
900	773	100
950	1490	(1.97 Atm.)
1000	2710	(3.57 Atm.)

ing and far advanced for the time hint that the effect of water vapor on the lime burning process is a favorable one. On the other hand the reason why this should be so is not clear. At any rate it may be said that the assumption made by Block to the effect that the water vapor is an indifferent factor and has but little effect in reducing the partial pressure of the carbon dioxide is not to be countenanced.

As far as the effect of water vapor is concerned, we have to deal with two equilibria, I and II, which are also inter-related with a third equilibrium, III, which simply controls the direct decomposition of calcium carbonate by means of water vapor. The first equilibrium is $\text{CaCO}_3 \rightleftharpoons \text{CaO} + \text{CO}_2$ — 45,000 calories. The second is $\text{Ca(OH)}_2 \rightleftharpoons \text{CaO} + \text{H}_2\text{O}$ — 25,200 calories, and the third is $\text{CaCO}_3 + \text{H}_2\text{O} \rightleftharpoons \text{Ca(OH)}_2 + \text{CO}_2$ — 17,300 calories.

At any given temperature equilibrium is characterized by a definite carbon dioxide pressure which is equal to p_1 . This is known from the data which are given in this article. Then again the equilibrium II is determined by a definite water vapor pressure which is placed equal to p_2 and which has been established by Johnston. In the case of the equilibrium III the total pressure of carbon dioxide and water vapor can be differently chosen at a given temperature. It is therefore in accordance with the natural law to say that the ratio K of the pressure of carbon dioxide to water vapor can be in equilibrium over the mixture calcium carbonate and calcium hydroxide. This ratio K is on the other hand given by the known decomposition pressures p_1 and p_2 which refer to the partial equilibria I and II, and for this reason the ratio K must be equal to the quotient p_1 by p_2 .

Hence, if the total pressure P is given, as for example, in the case of an incoming stream of steam in which P is equal to one atmosphere, then it becomes possible to calculate for any known temperature the partial pressures of p_{CO_2} over calcium carbonate as well as of $p_{\text{H}_2\text{O}}$ for water vapor.

Thus $p_{\text{CO}_2} + p_{\text{H}_2\text{O}} = P$, and K is equal to $\frac{p_{\text{CO}_2}}{p_{\text{H}_2\text{O}}}$. From this there is obtained the following:

$$p_{\text{CO}_2} = P \cdot \frac{K+1}{K} = P \frac{p_1}{p_1 + p_2}$$

$$p_{\text{H}_2\text{O}} = P \cdot \frac{1}{K+1} = P \frac{p_2}{p_1 + p_2}$$

If then the partial pressure of carbon dioxide is calculated, which is obtained while water vapor is passing over the calcium carbonate, it is found that this is lower than the decomposition pressure p_1 of calcium carbonate. Therefore at a given temperature a definite quantity of limestone will decompose more quickly in a current of air than in a current of water vapor, or steam under the same conditions of speed of travel of the stream of gas or vapor. The Herzfeld tests on the other hand gave exactly the opposite results.

It is in fact not easy to clear up this contradiction. Perhaps the speed of reaction is different in both reactions. For many technical processes the state of equilibrium is of less importance than the speed at which the equilibrium sets in under certain given conditions. Now it is known that water vapor acts as an accelerator in certain gas reactions and in heterogeneous systems. A large number of investigations have brought forth the conclusions that calcium oxide will not react with dry carbon dioxide gas. When moisture is present on the other hand, the reaction progresses, as is to be expected from the status of the equilibrium. It therefore appears not to be excluded that the decomposition of calcium carbonate with the aid of water shows a greater speed of reaction under similar conditions than the speed of thermal dissociation.

Furthermore, there is the possibility that the difference in the heat balance of both reactions has some effect. The decomposition with the aid of water vapor requires less heat than the thermal decomposition by an amount equal to the slaking heat or 25,200 calories. It requires only 17,300 calories of heat per molecule. Consequently if like volumes of air on the one hand and of water vapor on the other hand are passed over calcium carbonate, which is maintained at the same temperature in both cases, then a considerably greater exchange of heat can take place with the heat content of the water vapor which is considered to be equal at the start than with the heat in the air. Finally, consideration must be taken of the fact that the thermal capacity of water vapor is greater than that of air, whereby an increase in the heat transmission likewise takes place. However all these factors that appears to have an important bearing on the lime burning process have not been studied sufficiently to arrive at a clear understanding of their influence.

Variations in the Natural Limestone

The study that has been made up to

the present point has been based on chemically pure limestone, without taking in consideration in any way the source of the rock. Natural limestone varies considerably not only in respect to purity but also in regard to its physical structure. The physical structure of the limestone is not without certain influence on the practical lime-burning process. It has been observed that a dense, crystalline limestone burns more slowly than the less dense, amorphous variety. This difference in burning properties is so marked that in the case of dense limestone, which is burnt in large pieces, difficulty is experienced at times to attain complete burning of the core of the rock, and at times it is necessary to raise the temperature of the kiln over the aforementioned, most commonly used, maximum temperature of 1200 deg. C. to 1300 and even 1400 deg. C. This behaviour is in part due to the size of the pieces themselves which can be concluded from the thermal conditions that have been set forth in the article, and it is also due in part to the greater resistance that is offered to the diffusion of the carbon dioxide which is evolved from the limestone and has to pass through a layer of burnt lime.

It has been believed that it is possible to explain this condition by the formation of basic carbonates or by the formation of a solid solution of calcium carbonate in calcium oxide. But laboratory tests have not given concordant results in this connection. At a certain temperature the carbonate of lime gives a clearly defined decomposition pressure which remains constant during the entire decomposition process, and this decomposition pressure is entirely independent of the ratio in which calcium oxide and calcium carbonate exist in the solid residue. For this reason it is quite evident that the formation of solid solutions as well as the formation of basic carbonate are excluded from consideration.

Impurities in Limestone Increase Possibilities for "Dead Burning"

Finally there remains to be considered the effect of the impurities of the limestone on the practical lime-burning process. As long as these impurities are present in the carbonate form in the rock, such as carbonates of iron, magnesia or manganese, the decomposition of the limestone is not hindered by their presence for these carbonates all possess higher carbon dioxide pressures at a given temperature than calcium carbonate. Then again as far as the clay and quartz impurities in the limestone are concerned, the conditions of decomposition are also not disturbed for the reason that these impurities enter into no chemical reaction in the course of the lime burning. But the impurities reduce the sintering temperature of the limestone to

a considerable degree. At a temperature of 1100 deg. C., the impurities that are present in the carbonate of lime have the effect of producing a definite conversion and condensation of the limestone which results in its becoming more dense. This action takes place when the rock is subjected to this temperature for a rather long period of time and the action is even more emphasized when the temperature reaches higher limits.

Silica in the finely pulverized condition acts at a much greater speed than coarsely mixed quartz. Due to the sintering action the speed with which the lime is slaked in after treatment is reduced, and in fact the lime may be considered in this case to be in the same condition as when it is "dead burnt." At the start of this study it was mentioned that caustic lime is denser at higher temperatures. The condensation or compression of the particles of the substance on the other hand brings about a considerable difference in the value of the pure lime. However conditions are different when impurities such as silica, alumina, iron and the like are contained in the limestone in the finely pulverized condition. In this case the limestone is made to sinter and a certain proportion of new compounds are formed which results in the lime being in the "dead burnt" condition. Under such circumstances the lime will not slake. This is a very important matter when considered in connection with the high possible kiln temperature. It has been shown in what has preceded that one of the most efficient and desirable ways in which the lime burning process can be accelerated is to raise the temperature of the kiln to the highest possible point. But in the case of pure limestone which does not contain any of these impurities and hence which has no tendency to sinter, this goal may be approached closer than in the case of impure limestone which easily sinters. Furthermore, the study that has been made on this subject enables another conclusion to be drawn, namely, that in the case of a limestone which contains a definite amount of impurities the burning of larger pieces of rock, due to the fact that a higher temperature is required for carrying out the process, will result more easily in attaining the "dead burnt" condition, than when smaller pieces of the limestone are processed. Then again, when the character of the kiln is taken into consideration it may be said that sintering takes place more readily in lime that is burnt in a gas chamber kiln than in the regular shaft kiln.

Kiln Lining

Another matter which is of importance in the practical operation of the lime kiln is the proper selection of the material for making the lining of the kiln. The general rule has been that when the char-

acter of the product that is being treated in a furnace at high temperatures is acid, then that of the lining must be acid as well, and when the former is basic the latter must be basic. Hence it follows that the lining of the lime kiln must be basic. By basic materials are understood clay stone, the so-called firebrick, which

should contain in the burnt condition in order to give the best results for this purpose, 46% of alumina and 54% of silica, which really means that the firebrick is not basic at all. However, newer experience has taught that it is advisable to employ a material for lining the interior of furnaces which possesses a

more and more acid siliceous character, with a silica content of over 95%, irrespective of the character of the material that is being treated in the furnace. This applies as well to lime burning practice. The high temperature at which silica liquifies is an important advantage as far as lining of lime kilns is concerned.

The Use of Mineral Fertilizers Bound to Increase

Latest Experiments with Lime, Gypsum, and Rock Phosphate Show Interesting Results

By Professor George A. Olson

IN THE DESIRE to increase the use of various mineral fertilizers as the means of building up fertility and productive capacity of soils there is the probability of an occasional failure largely due to the fact that not enough attention is given to the problem of plant adaptation and plant tolerance. Also, the restricted practice of either liming soil, applying gypsum or rock phosphate is not always advisable because any one of these three ingredients may be neutral in effect, providing the problem is one of adaptation rather than of tolerance or of deficiency in plant food. On the other hand, through the use of the lime and gypsum, for example, it is possible to get the combined effect of these two products and, with the inclusion of rock phosphate, obtain three effects which will increase tolerance and yield of crop.

Obviously a suitable medium for the growing of crops does not necessarily benefit the plants since the soil may be lacking in either sulphate, phosphate, or both. Nitrogen need not be considered where legumes are grown and the soils are properly inoculated with suitable bacteria nor is it necessary to bother with the plant needs for potash in many soils since legumes secure nitrogen, as is well known, from the air supply and the potash is made available by means of base exchange phenomena.

There are numerous cases showing that liming has made the land favorable for the production of large yields of certain kinds of grain and clover and unsuitable for other varieties. Liming has also frequently proved helpful in suppressing action of substances which are toxic to plants and in increasing bacterial activity. In this connection it is of interest to know that some authorities hold that soluble alumina is toxic to plants and that lime renders it insoluble. Others contend that soluble alumina is only injurious to the extent that it unites with phosphoric acid and renders the phosphorus

unavailable to plants and to soil organisms. Many authorities have also shown that liming influences the efficiency of the phosphates and under entirely different conditions the rock phosphate and other insoluble forms of phosphate are as readily available as plant material as are the more soluble forms of phosphate without the use of lime.

Many experiments have been conducted recently to show that the beneficial effects resulting from the use of acid phosphate may be almost, if not entirely, due to the gypsum it contains rather than to the availability of the phosphorus as plant material. For example in bulletin No. 136 of the University of Idaho Agricultural Experiment Station it is shown that applications of gypsum resulted in net increases of \$18.89 for wheat, \$21.53 for meadow mixture and \$49.99 for alfalfa, as compared with phosphorus net increases of \$0.23 for wheat, \$0.71 for meadow mixture, and \$8.14 for alfalfa. The net increases for lime were \$4.53, \$4.21 and \$4.08 in the same crop order as mentioned above which clearly shows in this field that the gypsum functions primarily as a sulphate plant material. In other instances there has been observed a direct need for phosphorus which eclipses the influence of either lime or gypsum.

In bulletin No. 232 of the Iowa Agricultural Experiment Station data are presented which show that applications of gypsum in an Eldorado field increased the yield of oats from 4.8 to 15 lb. The soil showed a lime requirement of 2½ lb. of lime per acre. The combination of the lime and gypsum increased the yield of oats from 6.8 to 17 bushels per acre and the yield of clover 680 to 2100 lb. per acre while limestone used alone increase the yield of oats 5.8 bushels and clover 690 lb. Obviously the influence of the sulphate as plant material outweighed the benefit derived from the use of the limestone.

At Waverly, Iowa, lime, and lime and gyp-

sum applications decreased the yields of alfalfa while using gypsum alone increased the yields of alfalfa 800 to 1400 lb.

At Farson, Iowa, applications of gypsum increased the yield of clover from 40 to 460 lb. while lime decreased the yield 240 lb. In the light of such facts one would expect the combination of gypsum and limestone to tend to depress the yield. However, as noted at Waverly the combination gave increases of 380 to 760 lb. of clover per acre.

Other tests conducted in other parts of Iowa show that there is a need for sulphate treatment. The use of lime with the gypsum should prove most beneficial in those cases where the soils show response to lime treatment as well as to sulphate as plant material.

The low efficiency of rock phosphate in quartz sand and its high efficiency in other soil types indicates different kinds of soil reaction. Usually soils which contain much iron and aluminum respond to phosphorus fertilization. Finely ground rock phosphate known as floats, for example, is frequently used on acid soils which are high in organic matter and the more soluble forms of phosphate is extensively used on the heavier soils.

Some experiments recently conducted show that silica gel favorably influences the solubility of the phosphorus in rock phosphate and has aided in providing the phosphorus required by the plant.

It is evident that on the physical and chemical make-up of the soil its productive efficiency depends. A system of fertilization therefore which will improve the physical nature of the soil and bring about desirable base exchange will increase the efficiency of the soil as a producer. The natural untreated minerals, under certain conditions, participate in the base exchange phenomena and improve the physical condition of the soil. The task ahead of us is to make mineral fertilization active under all conditions.

The Effect of the Process of Manufacture on the Properties of Calcined Gypsum*

Part A—Effect of Fineness of Raw Gypsum and Calcination Temperature. Part B—Effect of Impurities in Raw Material

By L. E. Smith

IN reviewing the literature on gypsum, the lack of definite information as to the effect of the various processes of manufacture on the properties of the calcined product is apparent. In the course of time many changes have occurred in the processes of manufacture of calcined gypsum. However, little work has been done correlating the effects of these changes on the resulting product. With this in mind an investigation has been completed in which a study was made of the effect of the fineness of the raw material, the temperature of calcination and impurities in the raw material on the properties of the calcined gypsum. Inasmuch as the first two phases of the work were carried out in conjunction with each other they will be treated together.

Part A. The Effect of the Fineness of the Raw Gypsum and the Temperature of Calcination on the Properties of the Calcined Product

The gypsum used in this work was selected because of its relative purity and uniformity of composition. An analysis of the rock is given below:

	Per cent
Silica (SiO_2).....	0.14
Iron oxide (Fe_2O_3).....	0.05
Aluminum oxide (Al_2O_3).....	0.61
Calcium oxide (CaO).....	33.36
Sulfur trioxide (SO_3).....	47.31
Moisture at 45 deg. C.....	0.26
Combined water at 220 deg.....	18.08

Combined analysis indicates that the rock contains approximately 86.4% gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), 12.6% anhydrite (CaSO_4) and 1.0% silicious impurities.

The raw gypsum was first ground in a ball mill and then carefully sieved through three sizes of sieves, Nos. 50, 100, and 200.† This gave three definite sizes of the raw material to work with, that passing a No. 50 and retained on a No. 100 sieve, that passing a No. 100 and retained on a No. 200 sieve and that passing a No. 200 sieve.

The raw gypsum was calcined in a small rotary kiln. Fig. 1 is an illustration of the calciner used. About 1500 grams of raw gypsum were calcined in each run. Heat was supplied by means of electrical resist-

ance coils which were located inside the drum of the calciner. This method of heating was desirable, as by means of a slide wire resistance the time-temperature curve, Fig. 2, could be followed very closely with each run. The rotary kiln used gave a product that was uniformly calcined, as the heat was applied equally to all of the material, thereby eliminating any overburning or underburning.

The end points of the various calcinations

percentage water necessary to make a sanded mortar of a uniform consistency, the results being given in Table I. The consistency was arbitrarily taken to be a $\frac{1}{2}$ in. slump in a 2x4 in. cylinder. The percentage of water was calculated from the total weight of the materials used in each case. The mortars used in the time of set and tensile strength determinations were 1:2 gypsum-sand mixes, the sand used being standard Ottawa testing sand. Strength and plas-

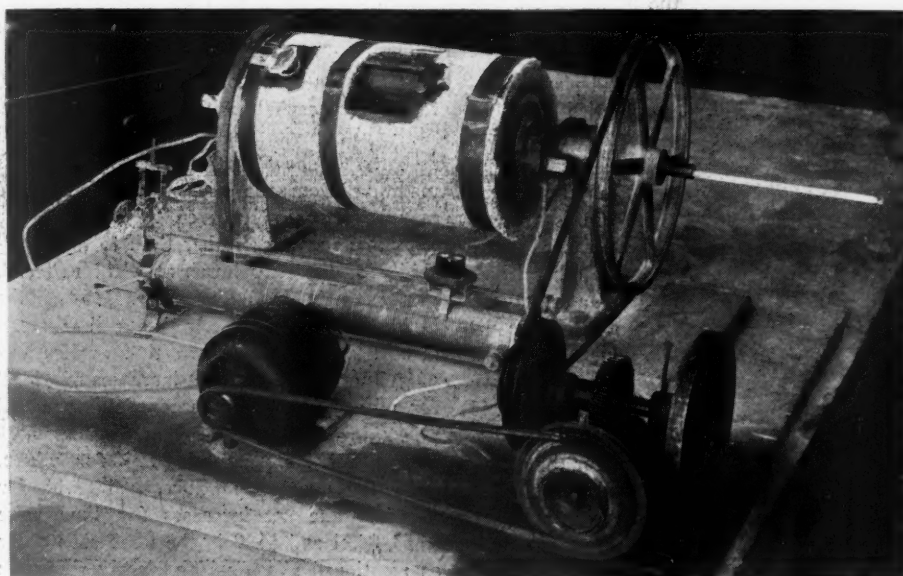


Fig. 1. Rotary kiln type electrical calciner for gypsum

are shown in Fig. 2, A being the run through the "second boil" with a total time of 195 minutes and a maximum temperature of 197 deg. C.; B is the run with a total time of 195 minutes as in A but with a maximum temperature of 117 deg. C., or just to the temperature of the "first boil"; C is the run to the "second boil" with a total time of 165 minutes and a maximum temperature of 172 deg. C.; D is the run just through the "first boil" with a total time of 130 minutes and a maximum temperature of 121 deg. C. After calcination the product was removed at once from the calciner and placed in air tight containers.

The properties of the calcined material studied were: fineness, plasticity, composition, time of set, tensile strength and per-

ticity tests were made of mortars of the consistency referred to above. The time of set was measured by means of the Vicat needle. A sieve analysis was made of both the raw and calcined gypsum. The tensile strength value as given in the table is the mean of three briquettes. The chemical analyses were made in duplicate and according to the method of Welch.¹ The figures given in the table are the average of two analyses, the percentages being calculated on the basis of di-hydrate plus hemi-hydrate plus soluble anhydrite.

¹Standard Specifications and Tests for Portland Cement, Serial Designation C9-21, A. S. T. M. Standards, 1924, p. 648.

²Analysis of Gypsum and Gypsum Products, F. C. Welch, Ind. and Eng. Chem., Vol. 16, No. 3, p. 238.

*Published by permission of the Director of the National Bureau of Standards of the U. S. Department of Commerce.

†U. S. Standard Sieve Series, Letter Circular 74, U. S. Bureau of Standards, 1924.

The plasticity figure was obtained by a method recently developed at the Bureau of Standards.³ At the time this work was done the method had been found applicable only to sanded mixes so the plasticity figure given represents the plasticity of a 1:3 gypsum-sand mix. Standard Ottawa sand was also used in these mixes. The measurements were made on a modification of the Emley plasticimeter and are believed to represent accurately the comparative plasticities of the mixes measured.

different points on the time-temperature curve, Fig. 2. Another thing which may be noticed is that in every case there is more nearly complete calcination when the material is sized to pass a No. 100 and be retained on a No. 200 sieve than when the other sizes of the same material are calcined. This conclusion is demonstrated by Fig. 2. For each set of runs, A, B, C, or D, there is an increase in the percentage of calcination for the size of material passing a No. 100 sieve and retained on a No. 200 sieve

that the strength varies with the degree of calcination, the size of the material remaining the same. However, in most cases the finer the material the greater the tensile strength. This is demonstrated by Fig. 5. The runs with each size of material give increasing tensile strengths going from the D run to the B run, to the C run and finally the A run. The runs are given in the order of their increase in time and (or) temperature of calcination.

The tests of plasticity of the various sam-

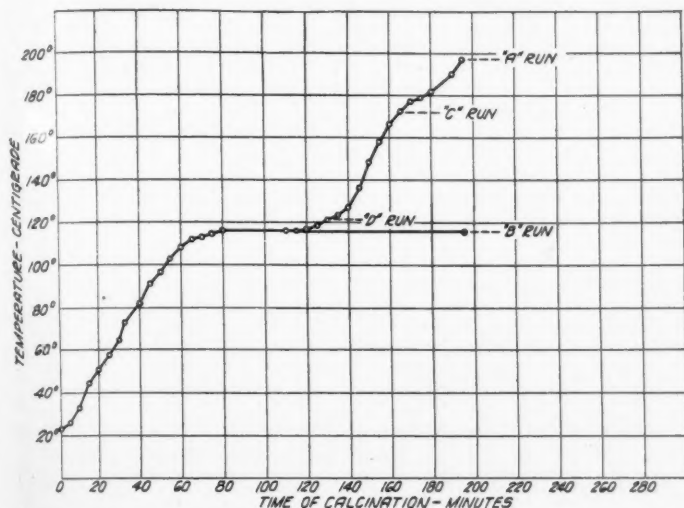


Fig. 2. Time-temperature curve for calcination of gypsum

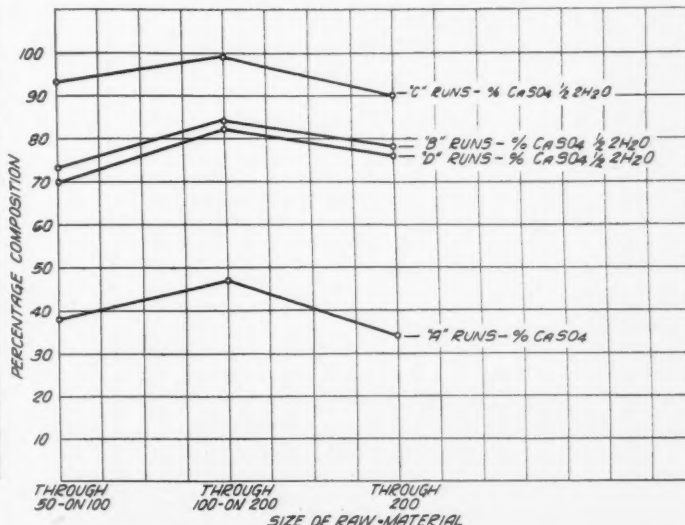


Fig. 3. Curves showing the relation between the size of the raw gypsum and the percentage of calcination

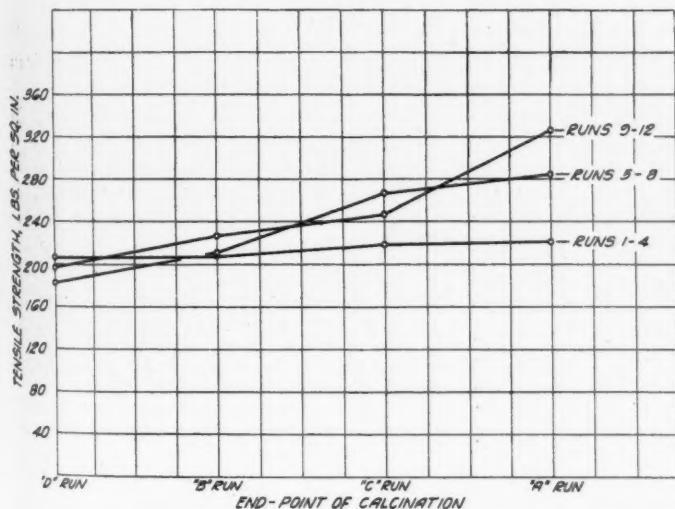


Fig. 4. Curves showing the relation between the end-point of calcination and the tensile strength of the resulting material

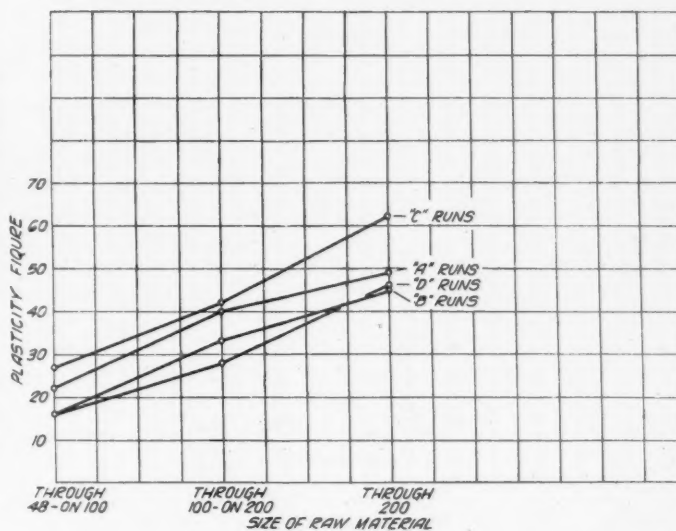


Fig. 5. Curves showing the relation between the size of the raw gypsum and the plasticity figure of the calcined material

A number of interesting facts are brought out by a study of the results obtained. From the chemical analyses it can be seen that all of the A runs give a large percentage of soluble anhydrite, the C runs give nearly all hemi-hydrate, the B runs give hemi-hydrate and relatively large amounts of di-hydrate, while the D runs give about the same as the B runs. The conditions of calcination were made as nearly the same as possible for each of the three sizes of material used and the calcinations were carried out to four

over and above the percentages of calcination for the other sizes of material. With the same sized material, continued heating at the "first boil" temperature on past the time of the D run gives only a small increase in hemi-hydrate; or in other words, when the "first boil" is complete, as at D, continued heating at the same temperature does not drive off much more water.

Tensile Strength Varies With Degree of Calcination

In general the tensile strength tests show

plasticity figures for the coarse material are low, while those of the finer materials are considerably higher. In other words, the finer the material the more plastic it will be when it is made into mortar. Another fact shown by the plasticity figures is that with each size of material, the runs made with a final temperature of 172 deg. C., or up to the "second boil," give a more plastic material than do the runs made through the "first boil." The materials calcined just through the "first boil" are the least plastic

³ Peter, J. P. C. Unpublished work.

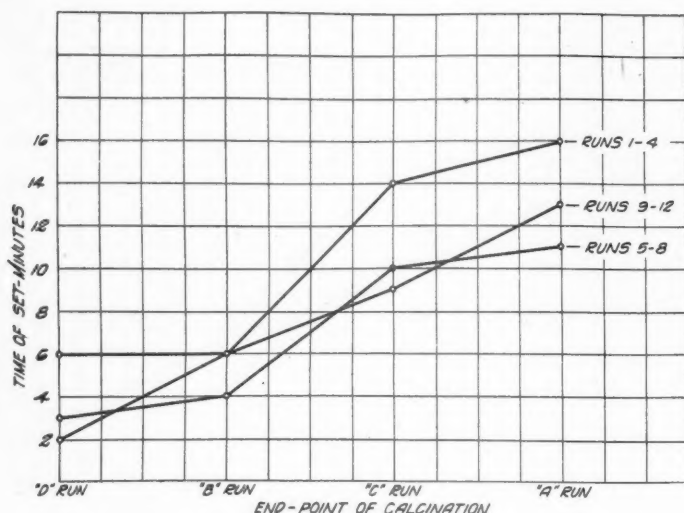


Fig. 6. Curves showing the relation between the end-point of calcination and the time of set of the resulting material

in each case. These conclusions are shown graphically in Fig. 5. With each set of runs as the fineness is increased there is an increase in plasticity. The *D* and *B* runs being nearly alike and with the lowest percentage of calcination give the lowest plasticity curves. The *C* runs, which give the material analyzing nearly all hemi-hydrate, give the highest plasticity curve. The *A* runs, which give varying amounts of soluble anhydrite, give a plasticity curve lower than the one for the *C* runs.

Finer Material Makes More Plaster Mortar

The results on the time of set show that the longer the calcination is carried out or the higher the temperature of calcination the slower the time of set.

This substantiates the work of Winterbottom.³ The time of set is then an indication of the amount of the di-hydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) present in the gypsum, and the less the amount present the slower the time of set will be. When all the di-hydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) has been converted to the hemi-hydrate ($\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$), and as soluble anhydrite (CaSO_4) is formed, the time of set is slowed up still more. This conclusion is verified by Fig. 6. Plotting increase in either time and (or) temperature of calcination against the time of set, using the times of set of runs made with the three sizes of materials, the curves formed all show an upward trend.

The results of the sieve analyses show

³ D. C. Winterbottom, Gypsum and Plaster of Paris, Bul. No. 7, Dept. of Chemistry, South Australia, p. 109.

that there is practically no change in the size of the raw gypsum during its calcination in a rotary calciner. While there is a small numerical variation in the percentages found, the figures no doubt lie within the limits of experimental error in making the analyses.

Part B. The Effect of Impurities in the Raw Material on the Properties of the Calcined Gypsum

This phase of the work was undertaken for the purpose of studying the effect of various impurities in the raw material with reference to the properties of the calcined gypsum. With the exceptions noted below, the materials used and the procedures carried out in the first part of this work were used in this phase of the investigation. The raw material was ground and sieved and that portion passing a No. 200 sieve was used in the calcination. The various impurities added were silica (SiO_2), salt (NaCl), calcium carbonate (CaCO_3), sodium sulphate (Na_2SO_4), magnesium carbonate (MgCO_3), iron oxide (Fe_2O_3), and magnesium sulfate (MgSO_4). Each impurity was ground to the same fineness as the raw gypsum and thoroughly mixed with the gypsum before

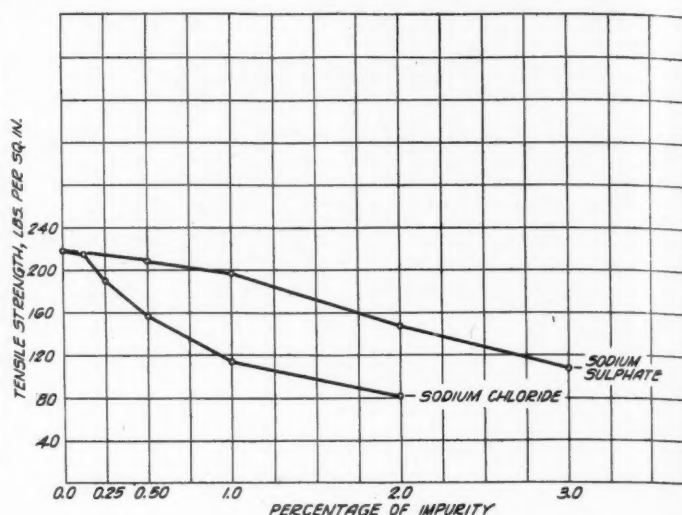


Fig. 7. Curves showing the relation between the percentage of impurity in the raw gypsum and the tensile strength of the calcined material

calcination. A total weight of 1500 grams was used for each run, and the temperature chart, Fig. 2, was followed as closely as possible. The temperatures of the "first" and "second boil" were lowered by the presence of the soluble salts, but no change was made in the total time of calcination.

The properties of the calcined material studied were, time of set, tensile strength, chemical composition and plasticity. Due to the presence of the various impurities, some of which were hygroscopic in nature, good analyses by the method of Welch could not be obtained, so the analyses were all made according to the method of the American Society for Testing Materials.⁴

The results of this work are given in Table No. II. Examination of these results indicates that, in the percentages used, only sodium chloride and sodium sulfate appear to be deleterious, although SiO_2 does decrease the tensile strength somewhat. When the other impurities were present the physical properties of the calcined material approximated those for the material containing no impurity. Runs were then made,

⁴ Standard Methods for Testing Gypsum and Gypsum Products, Serial Designation C26-23, A. S. T. M. Standards, 1924, p. 770.

TABLE No. II—EFFECT OF VARIOUS IMPURITIES

Run No.	Per cent H_2O added	Tensile strength, lb./sq. in.	Time of set, minutes	Impurity	Per cent anhydrite	Analysis—Per cent $\frac{1}{2}\text{H}_2\text{O}$	Per cent $2\text{H}_2\text{O}$	Plasticity figure
11	22.0	246	9.0	.....	0.0	90.0	10.0	62.0
13	21.3	177	11.0	5% SiO_2	0.0	92.0	8.0	47.0
14	23.0	52	3.0	2% NaCl	32.0	68.0	0.0	44.0
15	20.0	281	12.0	5% CaCO_3	0.0	96.0	4.0	41.0
16	21.3	.....	.....	3% Na_2SO_4*	.....	.....	.....	.....
17	23.1	239	15.0	5% MgCO_3	0.0	90.0	10.0	42.0
18	20.8	248	10.0	2% Fe_2O_3	0.0	95.0	5.0	44.0
19	22.0	240	3.0	3% MgSO_4	0.0	94.0	6.0	50.0

*Material very quick setting so no time of set or tensile strength could be determined. The size of material was changed, giving results shown in Table IV.

TABLE No. III—EFFECT OF SODIUM CHLORIDE

Run No.	Per cent NaCl	Per cent H_2O added	Time of set, min.	Tensile strength, lb./sq. in.	Analysis—Per cent		
					anhydrite CaSO_4	$\frac{1}{2}\text{H}_2\text{O}$ CaSO_4	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
3	0	23.3	14.0	218	0.0	93.0	7.0
21	2.0	24.8	5.0	81	49.0	51.0	0.0
22	1.0	25.3	7.0	115	41.0	59.0	0.0
23	0.5	23.5	14.0	157	3.0	98.0	0.0
24	0.25	23.4	14.0	190	2.0	98.0	0.0
25	0.125	23.3	14.0	215	0.0	94.0	6.0

TABLE No. IV—EFFECT OF SODIUM SULPHATE

Run No.	Per cent Na_2SO_4	Per cent H_2O	Time of set, min.	Tensile strength, lb./sq. in.	Analysis—Per cent		
					anhydrite CaSO_4	$\frac{1}{2}\text{H}_2\text{O}$ CaSO_4	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
3	0.0	23.3	14.0	218	0.0	93.0	7.0
31	3.0	20.4	4.0	108	0.0	89.0	11.0
32	2.0	21.3	5.0	148	0.0	97.0	3.0
33	1.0	21.8	8.0	198	0.0	99.0	1.0
34	0.5	23.8	13.0	212	0.0	94.0	6.0

using these two impurities and decreasing the percentage with each run until the product of calcination appeared not unlike the one when there was no impurity present. For convenience the run made with no impurity present is listed first in Tables II, III, and IV. The results of the runs when sodium chloride and sodium sulfate were present are given in Tables III and IV, respectively, and are shown graphically in Fig. 7. In the runs when these materials were present gypsum passing a No. 50 and retained on a No. 100 sieve was used. The reason for this was that this particular size was found to be the only one of the three sizes used which gave a material, the tensile strength of which could be measured, when the maximum amount of sodium sulfate employed was present.

In studying Table No. II it is noticed that with one exception the percentage of calcination is somewhat higher when the impurities are present. This may probably be attributable to the use of two different methods of analysis and to the impossibility of absolute duplication of the conditions of calcination. In studying the time of set there was found a shortening in some cases due to the presence of a soluble salt.

The results on tensile strength show that silica, sodium chloride, and sodium sulfate decrease the strength, while the other impurities apparently have little effect on this property.

The plasticity figures of the mixes made from the different runs seem to indicate that in all cases there is some lowering of the plasticity figure when any of the impurities are present. However, there seems to be some variance between the effects of the different impurities.

From a study of Table No. III it is observed that when sodium chloride is present much of the raw gypsum is changed to anhydrite during calcination. A study was made of the anhydrite formed under these conditions and it is believed that the sodium chloride in some manner has the property of converting the soluble anhydrite as it is formed into material resembling natural anhydrite. Either this is true or else the sodium chloride prevents the transformation

of the soluble anhydrite to the hemi-hydrate and ultimately to the di-hydrate when water is added, as all of the mortars made from this material were very weak. It was only when the percentage of sodium chloride had been reduced to 0.125% that a material was obtained which corresponded approximately to the same material calcined with no impurity present. It would seem, therefore, that with regard to the properties studied, the sodium chloride content of the raw material should be less than 0.125% if the manufacturer would escape the deleterious effects of this impurity.

In Table No. IV, which gives the results when sodium sulfate was present, it can be seen that when the gypsum contains 0.5% of sodium sulfate the properties of the calcined product are approximately the same as those of the corresponding material which contained no impurity. The chemical analyses indicate that between the limits of 3 and 1% the greater the amount of sodium sulfate present the less the conversion of the raw gypsum into the hemi-hydrate. When the percentage of sodium sulfate is further reduced to 0.5% then the dehydration appears to be about normal.

Conclusions

PART A

1. There is no appreciable change in the size of the particles of raw gypsum when it is calcined in an electrical rotary calciner.
2. Raw gypsum passing a No. 100 and retained on a No. 200 sieve calcines more readily than does coarser or finer gypsum.
3. In general the tensile strength of 1:3 gypsum-sand mixes is increased with increase of the time and temperature of calcination of the gypsum within the limits studied.
4. The plasticity figure of 1:3 gypsum-sand mixes is increased by increased fineness of the gypsum, increased by increasing the hemi-hydrate content, and decreased by the presence of artificial anhydrite.
5. The time of set of calcined gypsum is lengthened by an increase in the degree of calcination.

PART B

1. Of the various impurities studied, only sodium chloride and sodium sulfate proved deleterious when present in the raw gypsum although silica does lower the tensile strength.

2. The sodium chloride content in gypsum should be below 0.125% and the sodium sulfate content below 0.5% in order to escape deleterious effects on the properties studied.

Analysis of Lime

TWO methods for the determination of calcium oxide in the presence of calcium carbonate are described in the April number of *Industrial and Chemical Engineering*. These have been developed in the laboratory of the Great Western Sugar Co., Denver, Colo., and are said to have given satisfactory results. The methods are (1) titration with an iodine solution and (2) titration with a solution of zinc chloride.

The author comments on the difficulties in the proper analysis of lime as follows:

"Available lime" means nothing until it is known for what purpose it is available. In the ammonia industry available lime is determined by boiling the sample with an excess of ammonium chloride and titrating the liberated ammonia. A sample of portland cement, which may be considered an impure overburned lime, gave by this method 58.0%, by the iodine method 16.5, by zinc chloride method 12.5 and by the sucrose method 9.8%.

The writer believes that the method is yet to be devised that will give the calcium oxide in lime without giving some of the silicates and other compounds present. Even pure water breaks down some silicates and the amount broken down depends upon the amount of water, the time of contact and the temperature.

It is possible that a method might be devised by using anhydrous reagents. The writer did some work along this line with promising results, but the methods are not suited to factory work. There is always difficulty in getting, and keeping, anhydrous reagents.

Which of these methods gives the lime available in the sugar industry has not yet

TABLE No. I—SUMMARY OF RESULTS

Run No.	Temp. of calcination	Per cent H ₂ O added	Size of material	Time of set, min.	Tensile strength, lb./sq. in.	Analysis			Plasticity figure	Per cent through No. 50 sieve, retained on No. 100 sieve	Per cent through 100, on 200	Per cent through 200
						Soluble anhydrite CaSO ₄	Hemi-hydrate CaSO ₄ ½ H ₂ O	Di-hydrate CaSO ₄ 2H ₂ O				
1	A	24	Thru 50, on 100	16.0	221	38.0	62.0	0	21.0	Raw	88.1	1.1
2	B	20.8	Thru 50, on 100	6.0	208	0	73.0	27.0	16.0	Calcined	87.3	1.8
3	C	23.3	Thru 50, on 100	14.0	218	0	93.0	7.0	27.0	Raw	86.8	1.0
4	D	22.0	Thru 50, on 100	6.0	205	0	70.0	30.0	16.0	Calcined	85.6	1.5
5	A	24.0	Thru 100, on 200	11.0	284	47.0	53.0	0	40.0	Raw	85.5	2.5
6	B	19.3	Thru 100, on 200	4.0	209	0	84.0	16.0	33.0	Calcined	86	2
7	C	20.0	Thru 100, on 200	10.0	266	0	99.0	1.0	42.0	Raw	85.5	6.5
8	D	19.5	Thru 100, on 200	3.0	182	0	82.0	18.0	28.0	Calcined	85	7.3
9	A	23.5	Thru 200	13.0	326	34.0	66.0	0	49.0	Raw	82.2	17.8
10	B	20.8	Thru 200	6	226	0	78.0	22.0	45.0	Calcined	81.8	18.2
11	C	22.0	Thru 200	9	246	0	90.0	10.0	62.0	Raw	83	17
12	D	19.5	Thru 200	2.0	196	0	75.0	25.0	46.0	Calcined	84.1	15.9
										Raw	81.7	18.3
										Calcined	80.5	19.5
										Raw	87.4	12.6
										Calcined	86.5	13.5

been determined. The writer believes that one of these, probably the zinc chloride method, will give satisfaction.

Cement Chemistry and the Calcium Aluminates*

A Study of the Effects of Various Combinations of Calcium Aluminates and Calcium Salts on the Properties of Cements

By Henry Lafuma

THE first point to be considered in this study is the anhydrous aluminates. Definitely constituted aluminates of lime can be obtained by melting mixtures of alumina and carbonate of lime. Monocalcium aluminate, $\text{Al}_2\text{O}_3\cdot\text{CaO}$, as well as $\text{Al}_2\text{O}_3\cdot3\text{CaO}$, etc.

As far back as 1856 monocalcium aluminate was employed as a binding agent in the manufacture of crucibles for dessicating purposes. In 1865 Fremy indicated that mixtures of alumina and lime in convenient proportions, thus, $\text{Al}_2\text{O}_3\cdot\text{CaO}$, $\text{Al}_2\text{O}_3\cdot2\text{CaO}$, and $\text{Al}_2\text{O}_3\cdot3\text{CaO}$, when melted and finely pulverized, will give hydrates when mixed with water which acquire a considerable degree of hardness. The setting of these aluminates has been studied by individuals. One interesting aluminate is the one that was prepared by Dufrau, namely, $\text{Al}_2\text{O}_3\cdot\text{CaO}$, by means of the electric arc furnace, drawing a current of 1000 amp. This aluminate was stable in the air, was attacked by water with dissociation and precipitation of the alumina but it would not set with water as the other aluminates.

The mechanism of the phenomenon of setting of aluminates is perfectly clear. It is comparable in every way with the setting of mortar. It has been shown that a supersaturated solution is produced, which contains considerable alumina; then crystallization of very slightly soluble hydrated aluminate takes place and the setting of the cement is due to this crystallization.

Hydration of the Calcium Aluminates

The composition of the hydrated aluminates which are formed during the setting of the cement is a disputed matter. Various theories are held as to what happens. It is variously held that there is just simple hydration of the tricalcium aluminate, decomposition of the mono and bicalcium aluminates by water into alumina and hydrated lime, and the like.

It can be stated that there exists a hydrated calcium aluminate which yields up to water 1.08 grams of CaO per liter at the ordinary temperature. Thus a gelatinous alumina (about 1 gram of Al_2O_3) is agitated with 1 liter of water and an excess of lime, for example 4 grams of CaO , is added. After several days the material assumes a crystalline appearance. After dep-

osition, the solution is replaced by pure water until there is no longer any free lime present in the solid phase. At that moment all the lime is combined or dissociated.

After this has been done and the aluminate has been deposited, the lime is weighed into a known volume of supernatant liquid, 100 c. cm. for example. (It is said that there is no longer any alumina in the solution.) Then this volume of solution is replaced by distilled water and the same operation is repeated several times. Then the information is derived regarding the concentration of

THIS article is taken in part from a thesis written around the chemistry of cement making and cement use from the standpoint of the effect of calcium aluminates and the combinations of these aluminates and chloride of calcium and sulphate of calcium on the properties of the cement and its action under different conditions. The thesis has been much reduced in length.

CaO in solution as a function of the total quantity of lime that is removed. The results obtained from this experiment are as follows:

Total quantity of lime removed in grams	CaO in grams per liter in solution
0.00	1.30
0.13	1.17
0.25	1.08
0.36	1.08
0.70	1.07
1.15	1.08
1.24	1.08
1.35	0.98
1.46	0.89

It is seen that the amount of lime in solution decreases first proportionally in accordance with the volume of water added, and then when the content of lime in the wash water is decreased to 1.08 grams per liter, the addition of additional quantities of water does not change the content of lime in the solution. This of course happens when the system is allowed to remain for a long time in order to attain equilibrium, which practically takes a day or two, and during this time the mixture is being thoroughly agitated. Then when the aluminate is entirely decomposed, the concentration of the solution decreases again proportionately with the volume of water that is added to it.

Action of Water on the Aluminate $3\text{Al}_2\text{O}_3\cdot5\text{CaO}$

This aluminate is obtained by melting a mixture of alumina and carbonate of lime in proper proportions in a crucible which is lined with a paste of powdered charcoal and clay. About 10 grams of the finely pulverized aluminate is then stirred up with a liter of water. From time to time the lime and the alumina are determined in a filtered sample of the solution. The results that were obtained in this experiment are shown in the following:

Time	Grams per liter solution	
	CaO	Al_2O_3
Four hours.....	0.45	1.10
One day.....	0.44	1.27
Two days.....	0.39	1.00
Five days.....	0.36	0.73
Twelve days.....	0.39	0.57
One month.....	0.40	0.45
Three months.....	0.41	0.28
Four months.....	0.42	0.27
Seven months.....	0.41	0.19

When the aluminate $\text{Al}_2\text{O}_3\cdot3\text{CaO}$ is treated in the same manner, the results obtained after several months is CaO , 0.43 gram and Al_2O_3 , 0.18 gram per liter. It seems therefore that in both cases the same hydrated aluminate is formed and that the limit of hydration that is obtained is the limit of decomposition of the new hydrated aluminate which cannot be the tetracalcic aluminate, for that yields 1.08 grams of CaO per liter to the water solution.

However the alumina and the lime that are found in solution after a period of seven months do not show the limiting cases of the new hydrated aluminate. If, when aluminate is still present, the dilution of the liquid is increased, then it is found that the quantity of alumina in solution likewise increases, which indicates that there is still a little anhydrous aluminate present in the solution, which reacts with the added water, and solution of the superficial protective coating of hydrated aluminate over the granules is effected.

If the supernatant liquor is then replaced with water, it is found that after some time has elapsed no more than 0.16 gram of lime and a little alumina are dissolved per liter of solution. The solution attains that concentration after several additions of water.

From these experiments it may be concluded that there exists a hydrated aluminate which is less rich in lime than tetracalcic aluminate, and that an anhydrous

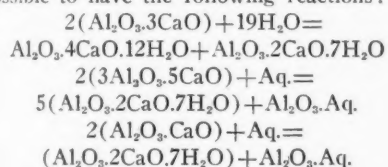
*Le Ciment, 1925 (174-183).

aluminate, in the presence of excess water, hydrates only imperfectly even after the lapse of a considerable period of time.

(The author has also investigated the aluminate which has the formula: $\text{Al}_2\text{O}_3 \cdot 2\text{CaO} \cdot 7\text{H}_2\text{O}$. He made some experiments to determine the manner in which this aluminate will hydrate in the presence of water and he also determined the exact composition of this salt. He found that the hydrated bicalcium aluminate was decomposed by water. At the ordinary temperature the decomposition stopped at a point where the concentration of the solution in lime was 0.16 gram per liter and that of alumina 0.05 gram per liter. By far the greater portion of the alumina, amounting to approximately 70%, was deposited.)

The experiments that have been made have shown that in a system which consists of alumina, lime and water, in a state of equilibrium, it is not possible to have any other solid phase than one of the following: Calcium hydrate, tetracalcium aluminate, bicalcium aluminate and aluminum hydrate.

Hence in the action of water on aluminates, either of definite composition or in the form of mixtures, there are finally two solid phases of composition preceding and following immediately after that of the anhydrous product. Thus for example it is possible to have the following reactions:

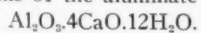


Action of Sulphate of Calcium on Aluminates of Calcium

From the standpoint of the chemistry of cement the most interesting property of the aluminates of calcium is the property which they have of combining with sulphate of lime, which then becomes insoluble in lime water. When cement which contains sulphate of calcium is agitated with an excess of water, it is found that at the beginning the clear decanted liquor contains sulphate of lime. But the content of sulphate in the liquor progressively decreases and ends up by containing none at all when there is sufficient alumina present in the cement. This is due, as has been shown before, to the formation of a sulpho-aluminate of lime.

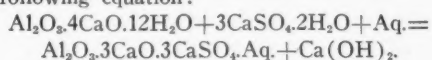
This salt is insoluble in lime water and is decomposed by water when the content of lime dissolved in the water is less than from 0.15 to 0.20 gram per liter.

In order to determine the action of sulphate of lime on tetracalcic aluminate, the following experiment is carried out: First there is dissolved in a liter of water 1.08 grams of lime and then there are added about 5 grams of the aluminate:



Under these conditions the aluminate is not decomposed. Then there are added 2 grams of dehydrated sulphate of lime at a low temperature. After agitation lasting 24 hr.

the filtered liquor contains 1.3 grams of lime and no grams of calcium sulphate per liter. The sulphate of lime has disappeared from solution, while the quantity of lime that is dissolved is greater than before the addition of the sulphate. There must therefore have been formed the sulpho-aluminate of lime, which sets free lime in accordance with the following equation:



It is a fact that when calcium sulphate in excess of that indicated in the above equation is employed, then the sulphate remains in solution. The quantity of lime dissolved in the solution is then less. This simply indicates that the lime is less soluble in solutions of sulphate of lime than in water.

Thus in the presence of sulphate of lime and an excess of lime, sulpho-aluminate of lime is the stable combination in which the alumina is found. If the sulphate of lime is present in sufficient quantity the aluminate will disappear in entirety.

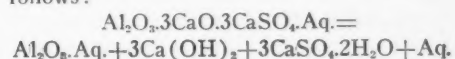
Preparation of Sulpho-Aluminate of Lime

The preceding experiment allows the recognition of the best conditions for the rapid preparation of sulpho-aluminate of lime. A milk of lime is used as the starting point as well as a solution of sulphate of alumina, the ratio of sulphuric acid to alumina being the same in the sulphate of alumina as in the sulpho-aluminate of lime. The commercial sulphate of alumina is freed from free sulphuric acid contained in it by heating to a temperature of approximately 400 deg. C. Then the sulphate of alumina is dissolved in boiling water. The solution of aluminum sulphate is then gradually added to the milk of lime, which should contain a slight excess of lime over the quantity calculated to correspond to the sulphate of alumina that is used in the method. The milk of lime is vigorously agitated between each addition of the sulphate of alumina. In this manner the solution remains saturated with lime. At each change of the appearance of the material the formation of sulpho-aluminate is recognized after a few minutes. The tetracalcic aluminate which can also be formed in a secondary reaction will be rapidly converted into the sulpho-aluminate by means of the sulphate of lime which is formed at the same time as the aluminate.

Action of Water on the Sulpho-Aluminate of Lime

About 10 grams of the sulpho-aluminate were then prepared starting with the sulphate of alumina and were separated from the liquor in which they were produced by filtration. The 10 grams were then placed in a liter of water. After a period of three to four days had elapsed, the solution contained the following amounts of dissolved ingredients per liter: 0.045 gram of lime, 0.11 gram of calcium sulphate and zero grams of alumina. The solution was allowed to remain in contact with the aluminate for

a month and at the end of this time the percentages of lime and sulphate of lime in solution remained unchanged. The sulpho-aluminate was again filtered and placed in contact with another liter of water. The same quantities of lime and sulphate of lime were dissolved. This indicates that this is the limit of decomposition of sulpho-aluminate by water at the ordinary temperature. The relation between the percentages of dissolved lime and sulphate of lime is interesting, being the same as that between their molecular weights. The reaction of decomposition may therefore be written as follows:



This reaction takes place at ordinary temperatures when there are in solution 0.045 gram of CaO and 0.11 gram of CaSO₄ per liter.

Action of Lime and Sulphate of Lime on the Sulpho-Aluminate

According to the equation of reaction for decomposition of sulpho-aluminate, as indicated above, it is seen that there is in this case a bi-variant system. There are four independent ingredients, namely, alumina, lime, sulphate of lime and water. There are two phases, one gaseous and the other liquid. There are two solids, alumina and sulpho-aluminate.

It is possible to fix arbitrarily at the ordinary temperature the quantity of lime or that of sulphate of lime in the solution. The concentration of the solution in any other substance is then determined.

The author has measured the quantities of lime which dissolve in solutions containing various proportions of sulphate of lime and the quantities of sulphate of lime which dissolve in various concentrations of solutions of lime. This is done by placing approximately 5 grams of sulpho-aluminate of lime in a liter of the solutions under consideration. Equilibrium is attained within three to four days. From the results which were obtained in this experiment it was found that the sulpho-aluminate of lime gives up a small quantity of lime to a solution which is saturated with sulphate of lime, while it gives up only inappreciable proportions of sulphate of lime to solutions that contain more than 0.4 gram of lime per liter.

(Another experiment was also made to determine the action of sulphate of lime on hydrated bicalcic aluminate.)

The final conclusion that is reached from this part of the investigation is as follows: Each time that the three substances, lime, sulphate of lime and alumina (capable of reacting with one another), are found together in an aqueous medium, sulpho-aluminate of lime is formed containing three molecules of sulphate of lime, whatever may be the proportions of the three initial substances. The amount of sulpho-aluminate formed in this way is determined by the minimum amount of the three initial substances in the mixture or which enters into

the combination. However if this substance is lime or sulphate of lime, a small quantity will remain in solution.

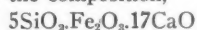
Sulpho-Silico-Aluminates of Lime

In seeking to determine the quantity of alumina in the state of calcium aluminate in cements by the quantity of sulphate of calcium which can fix the hydrated cement, Deval stated that the quantity of sulphate of lime which is fixed by the cements is greater than that which corresponds to the transformation of all the alumina into tricalcic sulpho-aluminate. This quantity seems to increase in some indefinite manner or other as the experiments are prolonged. It is thus that a gram of laboratory cement, having a composition as follows:



was found to have a fixed 0.187 gram of CaSO_4 at the end of 16 days, 0.226 gram of CaSO_4 at the end of two months and 0.315 gram of CaSO_4 after seven months while it could only fix 0.163 gram if all the alumina had been converted into the sulpho-aluminate with three molecules of sulphate of lime. This indicates that the cement fixed sensibly twice the amount of sulphate of lime that corresponds to the formation of the tricalcic sulpho-aluminate.

The sulphate of lime in the fixed condition and insoluble in lime water is combined and not absorbed by the silicate of lime, for a cement of the composition,



does not fix all of the sulphate of lime.

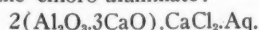
Certain experiments have been made by Deval to determine the action of sulphate of lime on hydrated silicate of lime, on the sulpho-aluminate of lime and on a mixture of these substances in equal parts. In no case was there any fixing of the sulphate of lime.

These experiments may be explained in the following manner. In the first place in the presence of an excess of lime, the silicate of lime fixes the sulphate of lime. Thus there is formed a sulpho-silicate of lime. Then again in the presence of an excess of lime the sulpho-aluminate fixes the sulphate of lime and a sulpho-aluminate of lime is formed which contains more than three molecules of sulphate of lime. Finally in the presence of an excess of lime, a mixture of silicate of lime and of sulpho-aluminate of lime fixes the sulphate of lime. In this way there is then formed a sulpho-silico-aluminate of lime in which the ratio of the sulphate of lime to alumina would be greater than three.

Action of Dilute Solutions of Sodium Chloride on These Salts

The sodium chloride that is found in sea water accumulates in mortars that are allowed to come in contact with this water. It has been said that this is due to a state of combination, but the exact nature of this combination has not yet been determined. Other investigators have also held that the mortar increases in both chlorine and sodium

content but is a proportion that is much too small to justify the hypothesis of a definite combination. According to M. L. Poirson, the solutions of 5% sodium chloride and 2% calcium chloride react on the aluminates in the cements and give rise to the formation of the chloro-aluminate:



According to Rebuffat the solution, containing 30 parts of chloride of sodium per 1000, attacks the aluminates and causing the solution of the lime and of the alumina. By heating a mixture of lime and chloride of alumina in a platinum tube to a temperature of 500 deg. C. there was obtained in addition to the aluminate described above the chloro-aluminate, $\text{Al}_2\text{O}_3, 3\text{CaO} \cdot \text{CaCl}_2, 10\text{H}_2\text{O}$.

Action of a Solution of Salt on Anhydrous Calcium Aluminates

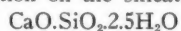
The author has agitated 10 grams of cement, in which calcium aluminate was the main ingredient, in a solution containing 3% of sodium chloride. From time to time a part of the liquid was filtered and the percentages of lime and alumina dissolved in it were determined. From the results that were obtained in this experiment it was concluded that the lime and alumina dissolve more rapidly in distilled water than in the saline solution. The maximum degree of supersaturation was attained between 8 and 20 hr. In the case of the saline solution, this maximum was attained only between the fifth and sixth day, but it was a greater maximum and the supersaturated condition disappeared more slowly. The persistence of supersaturation in the saline solution explains a condition which was assigned by Rebuffat to a disintegrating action on the aluminates of lime.

The action of saline solutions on the various hydrated salts which have been described above were also studied. The percentage of salt in the solution was maintained at 3% for the reason that this is about the concentration of salt in sea water. The sodium chloride by partial interchange of its base with lime or with the silicate and aluminates of lime tends to give rise to the formation of sodium hydroxide and sodium silicates and aluminates which are very soluble in water, while the corresponding calcareous compounds are only slightly soluble in water.

Action of Dilute Salt Solutions on Slaked Lime

When lime is dissolved in distilled water, saturation takes place when the solution contains 1.33 grams of lime per liter. A little more lime will dissolve in dilute solutions of sodium chloride. Thus when the solution contains 1% of salt the amount of lime at saturation is 1.56 grams and when it contains 3% of sodium chloride the amount is 1.75 grams.

The 3% solution of sodium chloride has a marked action on the silicate,

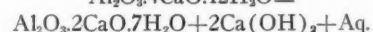
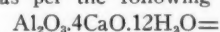


the aluminate,



the sulpho-aluminate and the sulpho-silico-aluminate of lime. This action is manifested in an augmentation of the limits of decomposition of these salts. However it is a fact that no total decomposition of the bicalcic aluminate or of the sulpho-aluminate ensues. When a 5% solution of sodium chloride is employed, the limits of decomposition of the silicate, the sulpho-aluminate and the sulpho-silico-aluminate of lime are still further increased to a slight extent. The action of this solution on the aluminates of lime, hydrated, is quite different, and gives rise to the formation of a new compound which is known as a chloro-aluminate of lime.

Experiments were also made to determine the action of the dilute sodium chloride solutions on hydrated tetracalcic aluminate. It was found that the number of grams of lime that are found in solution per liter at the saturation point was 1.08 when distilled water was used, 1.38 for a 1% salt solution, 1.60 for a 2% and 1.80 for a 3% solution. When the percentage of salt in solution was less than 3%, the tetracalcic aluminate was not decomposed, its limit of decomposition being lower than the solubility of the lime. For the 3% solution the limit of decomposition is a little greater than the solubility of the lime. The aluminate is accordingly decomposed as per the following equation:



It is also concluded from these experiments that the bicalcic aluminate is the only one that is stable in a solution containing 3% sodium chloride.

Additional experiments were made on the action on a 5% salt solution on hydrated tetracalcic aluminate. In this case it was found that a new compound was formed which was a chloro-aluminate of lime.

The final conclusion that can be reached regarding the behavior of the aluminates of lime that are found in cement in the presence of a 5% solution of sodium chloride or of calcium chloride as well is that these aluminates are converted into chloro-aluminate of lime, which has the following formula:



Bicalcic aluminate and alumina are also set free.

Of course the most interesting of conclusions that are reached above refer to the action on sulphate waters and seawaters on cement. The disintegrating action of these waters is due to the formation of a sulpho-aluminate of lime which causes the swelling of the cement. It has also been shown that the sulphate of lime which is fixed by the cement during the setting period has not this deleterious action on the cement, but it is rather the action of the sulphate on the hardened cement that is to be feared. This conclusion is borne out by the experience that has been gained with the use of super-aluminous cements, of which the principal constituent is monocalcic aluminate. These cements are not decomposed by sea water and sulphated waters. The ex-

planation of this phenomenon is simply that the sulpho-aluminate is not formed with these cements.

It is a fact however that the action of sea water on cement is a very complicated one due to the fact that there are many different salts in solution in the water. The magnesium salts act on the free lime in the cement to form the chlorides and sulphates of magnesia and lime. These salts can in turn react with the aluminates in the cement.

Tests were made to determine the decomposing action of water on cement. The hydration of cements gives rise to the formation of silicates, aluminates and sulpho-aluminates of lime whose limits of decomposition have been determined above. The hydration tests were made over a period of five months on finely ground cement. It was held that the hydration must have been completed at the end of that time, and accordingly 50 ccm. of the solution were decanted for determination of the dissolved lime. This operation was repeated three times at more or less great intervals and thereafter the 150 ccm. of solution removed were replaced with the same volume of distilled water. The operation was then repeated until all of the lime in the cement had dissolved. This made it possible to study carefully the limits of the decomposition of the hydrated compounds, that have been referred to above, in the form of cement.

In one case a siliceous cement was studied which had the formula of $10\text{SiO}_2 \cdot \text{Al}_2\text{O}_3 \cdot 32\text{CaO}$. It was found in this case that the limit of decomposition of the silicate $\text{CaSiO}_3 \cdot 2.5\text{H}_2\text{O}$ was 0.052 gram per liter. When the silicate is entirely decomposed, then lime is no longer dissolved in the fresh wash waters that are added.

In another case a rapid setting cement was studied, which contained much alumina and sulphate of lime. In this case the manner of decomposition by water was entirely different than above. No crystals were deposited on the sides of the vessel, and after five months the solution contained 1.08 grams of CaO per liter. This is the quantity of lime that corresponds to the limit of decomposition of the aluminate, $\text{Al}_2\text{O}_3 \cdot 4\text{CaO} \cdot 12\text{H}_2\text{O}$.

Tests were also made on slag cements. In this case 50 grams of the slag cement were placed in a liter of water. The flask was stirred very vigorously and from time to time a portion of the liquor was taken and filtered and the proportion of lime in solution was determined. This varied from 134 grams per liter after 10 minutes to 1.08 grams per liter at the end of two weeks. There was never any alumina in solution. It is thus evident that at the beginning solution of the rich lime added to the granulated slag takes place. This lime, however, gradually combined with the slag, and the tetracalcic aluminate was formed.

Attention was also paid in these studies to the effect of the addition of rich lime to cements. As far as the rapid setting cements are concerned, it is known that in slaking

the cement, the lime is dissolved as well as the alumina and the sulphate of lime. The rapid setting powers of the cement are due to the subsequent crystallization of the tetracalcic aluminate and the sulpho-aluminate of lime.

When rich lime is added to the cement the solution of lime retards the solution of the tricalcic aluminate. Aluminum hydrate forms slowly and the setting of the cement is retarded. When pure tricalcic aluminate is employed in the place of cement the same phenomenon is observed. On the other hand, the results are entirely different when a cement of high alumina content is employed.

Experiments were also made to determine the effect of the addition of rich lime to granulated slags. In hydration the granulated slag combines with the milk of lime without first dissolving. The hardening of such cement is due only to the hydration of the lime silicate. If the slag contains too little alumina, then it is inert and does not set. If it contains too much alumina, the forces of disintegration, due to the formation of aluminate, can impede the hardening effect which is due to the hydration of the silicate. Hence it follows that in order to have a good slag cement, it is necessary to select a slag which contains the optimum proportion of alumina.

In the last sections of this article there are discussed the effects of sulphate of lime waters and seawater on cement. The study showed that it was possible to derive a ratio, $\text{SiO}_2 + \text{Al}_2\text{O}_3$

which is expressed as follows: $\frac{\text{CaO}}{\text{SiO}_2 + \text{Al}_2\text{O}_3}$
If the ratio in any cement is found to be equal to unity or greater than unity, then it has been found that such a cement will not be decomposed by sulphate of lime. Experiments substantiate this fact.

As far as sea water is concerned, the action on cement is quite different from that of sulphated waters. For example, aluminous cements, which are decomposed by sulphated waters, are not affected at all by sea waters. The difference is due to the fact that sulphate of lime reacts on the tetracalcic aluminate in the first case, and on the bicalcic aluminate, which is rendered insoluble by the presence of free lime, in the second case.

Effect of Sulphate Solution on Constituents of Cement

IN a previous paper by G. R. Shelton published in the June number of *Industrial and Engineering Chemistry* concerning the action of "alkali" waters on portland cement the author discussed the effect of solutions of sodium and magnesium sulfates on the compounds present in portland cement clinker. This paper was printed in abstract in the October 3 issue of *Rock Products*. The present investigation comprises an extension of those tests to include the calcium aluminates, which are the only other compounds in the ternary system

$\text{CaO-Al}_2\text{O}_3\text{-SiO}_2$ having cementing properties on hydration. Of these the 5:3 calcium aluminate ($5\text{CaO} \cdot 3\text{Al}_2\text{O}_3$) and the monocalcium aluminate ($\text{CaO} \cdot \text{Al}_2\text{O}_3$) are important constituents of high-alumina cements, which cements withstand the disintegrating action of sulfate solutions for a much longer time than does portland cement.

The compounds 5:3 calcium aluminate ($5\text{CaO} \cdot 3\text{Al}_2\text{O}_3$), monocalcium aluminate ($\text{CaO} \cdot \text{Al}_2\text{O}_3$), and 3:5 calcium aluminate ($3\text{CaO} \cdot 5\text{Al}_2\text{O}_3$) were prepared in the same manner as the calcium silicates, the heat treatments being so conducted that the resulting clinker in each case was well sintered but not fused. The raw materials were commercial alumina and powdered white marble.

These substances in their crystalline and hydrated form were treated with solutions of sodium and magnesium sulphates of different concentrations and the changes brought about observed with the aid of a petrographical microscope. The principal changes observed are noted in an article in the December issue of *Industrial and Engineering Chemistry* and are given in brief form as follows:

The hydration products of the three calcium aluminates, $5\text{CaO} \cdot 3\text{Al}_2\text{O}_3$, $\text{CaO} \cdot \text{Al}_2\text{O}_3$, and $3\text{CaO} \cdot 5\text{Al}_2\text{O}_3$, are hydrated tricalcium aluminate and amorphous matter differing from that of $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, which is hydrated tricalcium aluminate only. The amount of gel increases with the increase in proportion of alumina in the compound. The time required for complete hydration increases with the alumina content of the compound.

The formation of sulfoaluminate crystals is characteristic of the reactions between calcium aluminates, crystalline and hydrated, and solutions of sodium sulfate in all concentrations, and also of magnesium sulfate in concentrations below 0.1 M. Above this concentration of the latter salt the only crystalline product is gypsum. Very large quantities of sulfoaluminate crystals are formed from the hydrated aluminates and dilute sulfate solutions, amorphous grains in the original hydrated suspension being largely used up in the process.

Layers of gel surround the crystalline aluminate grains, protecting them from further sulfate action, and are more plentiful in solutions of magnesium sulfate, probably being composed in part of amorphous magnesium hydroxide. The protection to the crystalline grains afforded by the gelatinous layers is most effective in the most concentrated solutions of both sodium and magnesium sulfate, and also with the aluminate having the highest alumina content.

With the crystalline aluminates and the most dilute sulfate solutions hydrated tricalcium aluminate crystals either did not form or disappeared soon after being produced. This is very different from the behavior of crystalline tricalcium aluminate in such solutions. In the latter case the hydrated crystals grow to a large size and remain unchanged for several months.

Hints and Helps for Superintendents

Hand-Operated Derrick on Pontoon for Changing Pipe

THE addition or subtraction of lengths of pipe to a line used in dredging is something of a job when there are no proper preparations for the work. Often it is accomplished by a combination of "main strength and awkwardness" that delays the dredge for half a day and leaves everyone connected with the job exasperated. When

The addition of a pipe length to the line is made at the joint near the pontoon. The pipe to be put in is lifted by the derrick and the line is broken at the flanged union and pulled apart. Then the pipe is let down so that an end may be bolted to the flange. Afterward the other end is brought in line by swinging the boom and raising or lowering the pipe so that it may be bolted on. All the bolts in the flanges are tightened and the line is ready for the pump.



A derrick on a dredge line pontoon is handy for changing pipes and other purposes

proper arrangements are made the work can be done in a short time and the dredge is delayed for only a few moments.

The picture shows the method employed by the Price Sand Co. on one of its dredges on the Arkansas river near Tulsa, Okla. A light stiff-leg derrick is mounted on one of the steel pontoons that supports the pipe line and this is used to handle the pipe during the operation.

The stiff-leg is made of 4-in. and 6-in. channel irons with a piece of 4-in. pipe for a boom. The boom is fastened to the mast at the bottom and the mast is set in a simple step bearing at the bottom and through a hole in a strap iron which connects the two stiff-legs at the top. This allows it to turn, carrying the boom with it.

For hoisting there are two small hand winches on which a $\frac{1}{4}$ -in. wire rope is wound. The ropes go through blocks and falls. One set of these raises and lowers the boom and the other raises and lowers the pipe.

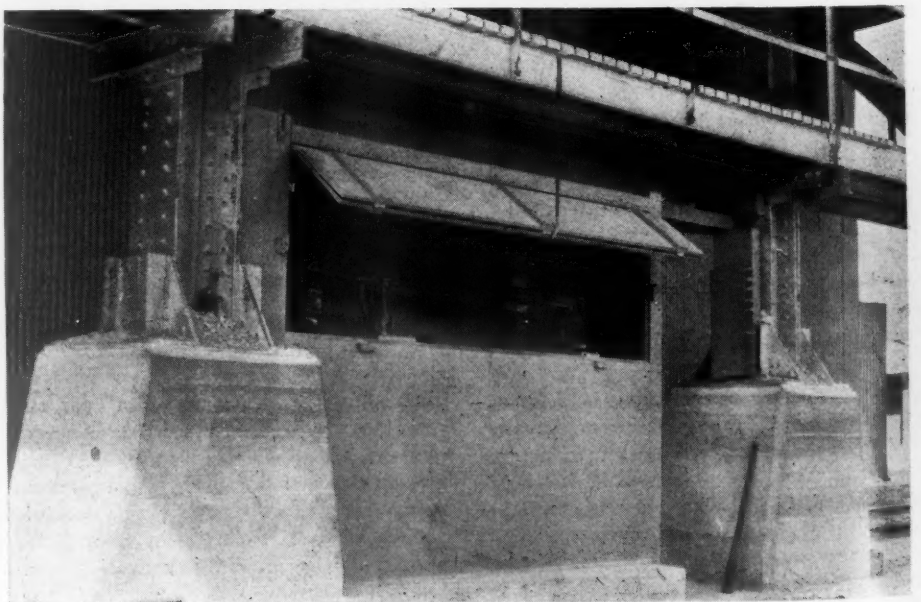
The Arkansas river has a rather swift current and the pontoon and the dredge have to be securely anchored when the line is broken. But when this is done the work of lengthening or shortening the line requires only a few minutes.

The pontoon with the derrick has proved itself useful in other ways. It has been temporarily disconnected from the line and used as a small derrick boat to handle anchors or to aid in installing machinery aboard the dredge.

Electric Lights Signal for Safe Loading

A NEAT DEVICE has been worked out at the Krause, Ill., plant of the Columbia Quarry Co., St. Louis, Mo., to insure safety in loading out of the plant bins. There are two loading tracks. Track scales extend under both tracks the full length of the bins. The bin gates are operated from an elevated platform, shown in the right-hand corner of the view (of the scales) herewith.

In the upper left-hand corner of the box containing the scale mechanism are eight colored, electric-light bulbs, each with two push-button switches. There is a bulb for each bin. Before a bin gate is opened to load a car, the light for that particular bin to be tapped is switched on. There is another corresponding light at the top of the bin in parallel with the scale light. This warns the man at the top of the bins that that bin gate is going to be opened. If he is ready to have the bin gate opened he



The lights are placed in the scale box in the upper left-hand corner

switches off both lights simultaneously by pressing a button near the light, and the scale man gives the word to open the gate. This signal system prevents the gate being



Looking up into the scale box showing one light burning

opened when the man at the top is in the bin, or dangerously close to it.

Clarence Klaus is superintendent of this plant and C. E. Glasson chief engineer in charge of construction.

Device for Opening and Closing Car Doors

A METHOD of opening and closing car doors which is new, to the writer at least, is shown in two photographs accompanying this. It is in use at the Alice plant of the Birmingham Slag Co. at Birmingham, Ala., and it was devised for their use by a local iron foundry.

The car is of a familiar side-door type with a center like a roof to throw the material to both sides when the doors are opened. The movement of the doors is controlled by

a disk and two bent levers which are shown in the picture.

When it is desired to empty the car a man sticks a bar in one of the holes shown on the edge of the disk and gives it a pull. The turning of the disk forces the ends of the levers out and as these levers are fastened to the bottom of the doors, the doors are opened. When the doors are to be closed the bar is inserted and the disk moved in the other direction. The cuts show the disk and the levers with the doors both opened and closed.

The advantage of this system is that the doors are closed and locked tight with no danger of being unlatched and opened until the discharge point is reached. The length of the bent levers is such that when the pins on the disk are about on center the door is shut tight. This locks everything securely in the closed position. The doors stay wide open until they are to be closed as there is no strain that tends to move the disk. By having a disk at either end of the car, both ends of each door may be drawn tightly against the sides of the car.

A Good Arrangement for Loading Mixed Sizes from Bins

IN several parts of the United States there is a strong demand for mixed aggregates—either a mixture of sizes of crushed stone or gravel or mixtures of sand and gravel, to be used as a complete aggregate, needing only the addition of cement to make concrete.

In making mixtures of aggregate it does not do to load one size first and then the other as it is hard to unload the car so that the mixture is uniform. The best that can be done is to bed the car carefully putting all of one size on the bottom and filling in the other sizes in layers above it. If such a carload is unloaded with a locomotive crane to a stockpile, the pile will be found fairly uniform throughout.

However, a better way is to draw the

required amount from each bin and run it on a conveyor belt. The belt discharge will then be a thorough mixture of sizes when it falls into the car. An arrangement of this sort is shown in the accompanying picture which was taken at the plant of the Camp Concrete Rock Co., Brooksville, Fla.

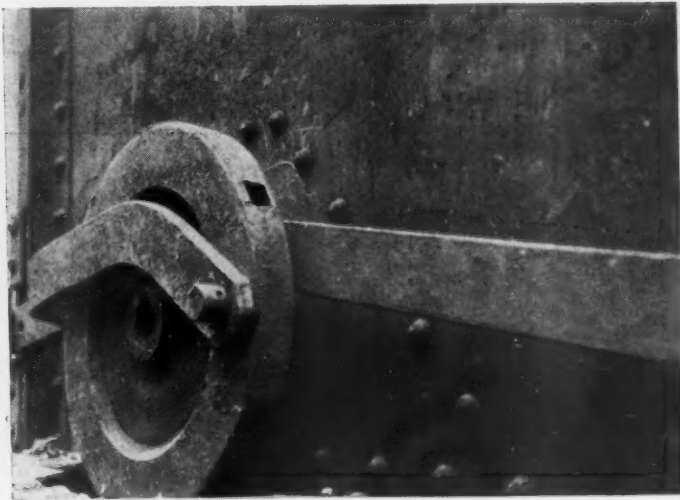
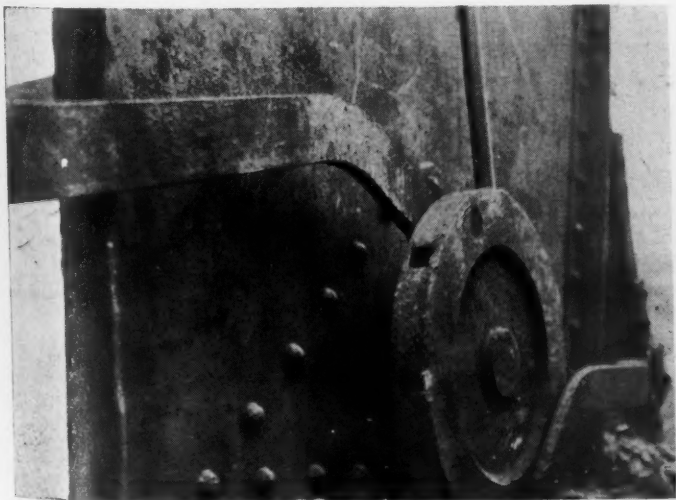
The bins have hopper bottoms in each of which is one or two gates of a type that can be set to a definite opening, such as the flat plate gate which is opened and closed by a screw. Short chutes below each gate turn the flow in the direction the belt is



The conveyor under the bins and the chute to the cars

moving and reduce the wear on the belt.

The chute by which the discharge from the conveyor is run into the car is arranged to serve another purpose, that of giving the material a final wash. The frame over the chute holds three spray pipes and these are connected to a water pipe above. The bottom of the chute is of heavy screen cloth and the water flows through this into a spout that sticks out at one side which does not show very clearly in the picture.



Left—The doors are opened by inserting a bar in the square hole and pulling forward. Right—Levers in the closed position

Financial News and Comment

RECENT QUOTATIONS ON SECURITIES IN ROCK PRODUCTS CORPORATIONS

(These are the most recent quotations available at this printing. Revisions, corrections and supplemental information will be welcomed by the editor.)

Stock	Date	Par	Price bid	Price asked	Dividend rate
Alpha Portland Cement Co. (common) ²	Apr. 27	100	119	123	1 3/4% quar. 25% ex. Dec. 1
Alpha Portland Cement Co. (preferred) ²	Apr. 27	100	114	-----	1 1/2% quar. Sept. 1
Arundel Corporation (sand and gravel—new stock).....	Apr. 27	No par	32 1/2	32 1/2	30c quar., Apr. 1
Atlas Portland Cement Co. (common) ²	Apr. 26	No par	45 3/8	47 1/2	50c quar.
Atlas Portland Cement Co. (preferred) ²	-----	100	-----	-----	2% quar. Oct. 1
Atlas Portland Cement Co. (preferred) ²	Apr. 27	33 1/2	44	47	2% quar. Oct. 1
Bessemer Limestone and Cement Co. (common) ⁴	Apr. 26	100	135	145	1 1/2% quar. Jan. 1, 4% ex. Jan. 1
Bessemer Limestone and Cement Co. (preferred) ⁴	Apr. 26	100	106	108	1 3/4% quar. Jan. 1
Bessemer Limestone and Cement Co. (convertible 8% notes) ⁴	Apr. 26	-----	120	130	8% annual
Boston Sand and Gravel Co. (common) ¹⁰	Apr. 23	100	65	68	2% quar. July 1
Boston Sand and Gravel Co. (preferred) ¹⁰	Apr. 8	-----	-----	75	1 3/4% quar. Oct. 1
Boston Sand and Gravel Co. (1st preferred) ¹⁰	Apr. 8	-----	-----	85	2% quar. Oct. 1
Canada Cement Co., Ltd. (common) ¹¹	Apr. 27	100	102 1/2	103 3/4	1 1/2% quar. Apr. 16
Canada Cement Co., Ltd. (preferred) ¹¹	Apr. 23	100	114	115	1 3/4% quar. May 15
Canada Cement Co., Ltd. (1st 6's, 1929) ¹¹	Apr. 23	-----	102	103	3% semi-annual A&O
Canada Crushed Stone Corp., Ltd. (6 1/2's, 1944) ¹¹	Apr. 23	100	93	96	-----
Charles Warner Co. (lime, crushed stone, sand and gravel).....	Apr. 23	No par	22	24	50c quar. Apr. 12
Charles Warner Co. (preferred).....	Apr. 23	100	100	-----	1 3/4% quar. Apr. 22
Charles Warner Co. (lime, crushed stone, sand and gravel) 7's, 1929 ¹⁶	Apr. 23	100	103	105	-----
Cleveland Stone Co.	Apr. 27	-----	168 3/8	169	1 1/2% quar., Mar. 1, 1% ex. Mar. 1
Connecticut Quarries Co. (1st Mortgage 7% bonds) ¹⁷	Apr. 23	100	103 1/2	-----	-----
Consolidated Cement Corp. (1st Mort., 6 1/2's, series A) ²⁸	Apr. 28	-----	-----	98 1/2	-----
Dexter Portland Cement Co. (6% serial bonds, 1935) ²⁴	Apr. 26	-----	96@98	100	-----
Dolese and Shepard Co. (crushed stone) ⁷	Apr. 28	50	82	85 1/2	\$1.50 quar. Apr. 1
Giant Portland Cement Co. (common) ²	Apr. 27	50	35	40	3 1/2% s.-a. Dec. 15, plus 10% arrears
Giant Portland Cement Co. (preferred) ²	Apr. 27	50	44	47	\$1 quar. Jan. 2, 50c ex. Dec. 27
Ideal Cement Co. (common).....	Apr. 26	No par	70	74	1 3/4% quar. Jan. 2
Ideal Cement Co. (preferred) ⁶	Apr. 26	100	107	110	\$1 quar. Mar. 31
International Cement Corporation (common).....	Apr. 27	No par	59 3/8	59 3/8	1 3/4% quar. Mar. 31
International Cement Corporation (preferred) ²	Apr. 26	100	102 1/2	102 3/8	-----
International Portland Cement Co., Ltd. (preferred).....	Mar. 1	-----	30	45	-----
Kelley Island Lime and Transport Co.	Apr. 27	100	120	122	\$2 quar. Apr. 1
Lawrence Portland Cement Co. ²	Apr. 27	100	110	-----	2% quar.
Lehigh Portland Cement Co. ⁶	Apr. 26	50	88	90	1 1/2% quar.
Lyman Richey Sand and Gravel Co. (1st Mort. 6s, expire serially up to 1930) ¹²	Apr. 24	100	99	100	-----
Lyman Richey Sand and Gravel Co. (1st Mort. 6s, expire serially from 1930 to 1935) ¹²	Apr. 24	100	97	99	-----
Michigan Limestone and Chemical Co. (common) ⁶	Apr. 26	-----	25	-----	-----
Michigan Limestone and Chemical Co. (preferred) ⁶	Apr. 26	-----	25	-----	1 3/4% quar. Apr. 15
Missouri Portland Cement Co.	Apr. 27	25	52 1/4	52 1/4	50c quar. Apr. 30
Monolith Portland Cement Co. (common) ⁹	Apr. 23	-----	10 3/4	11 1/4	-----
Monolith Portland Cement Co. (units) ⁹	Apr. 23	-----	26 3/4	28 1/4	-----
Monolith Portland Cement Co. (preferred) ⁹	Apr. 23	-----	8	8 1/4	-----
Nazareth Cement Co.	Apr. 20	No par	37	39	75c quar. Apr. 1
Newaygo Portland Cement Co. ¹	Apr. 26	-----	125	140	-----
New Egyptian Portland Cement Co. (preferred) with common stock purchase warrants ²¹	Mar. 27	100	99	102	-----
New England Lime Co. (Series A, preferred) ¹⁴	Jan. 29	100	96 1/2	99	-----
New England Lime Co. (Series B, preferred) ²²	Apr. 27	100	92	95	-----
New England Lime Co. (V.T.C.) ²²	Apr. 27	-----	35	38	-----
New England Lime Co. (6s, 1935) ¹⁴	Apr. 26	100	99	100	-----
North American Cement Corp. 6 1/2's 1940 (with warrants).....	Apr. 25	-----	93	98	-----
North American Cement Corp. (units of 1 sh. pfd. plus 1/2 sh. common) ¹⁹	Apr. 8	-----	94	99	2 mo. period at rate of 7%
North American Cement Corp. (preferred).....	Dec. 31	-----	-----	-----	1.75 quar. May 1
Pacific Portland Cement Co., Consolidated ⁵	Apr. 24	100	91	92	1/2% mo.
Pacific Portland Cement Co., Consolidated (secured serial gold notes) ⁵	Apr. 24	-----	100	100 1/4	3% semi-annual Oct. 15
Peerless Portland Cement Co. ¹	Apr. 26	10	5 3/4	6 1/4	-----
Petoskey Portland Cement Co. ¹	Apr. 26	10	9 1/2	10 1/2	1 1/2% quar.
Rockland and Rockport Lime Corp. (1st preferred) ¹⁰	Apr. 8	100	98	98	3 1/2% semi-annual Feb. 1
Rockland and Rockport Lime Corp. (2nd preferred) ¹⁰	Apr. 8	100	-----	70	3% semi-annual Feb. 1
Rockland and Rockport Lime Corp. (common) ¹⁰	Apr. 8	No par	-----	50	1 1/2% quar. Nov. 2
Sandusky Cement Co. (common) ¹	Apr. 13	100	120	127 1/2	\$2 quar. Apr. 1
Santa Cruz Portland Cement Co. (bonds) ⁸	Apr. 24	-----	105 1/4	106	6% annual
Santa Cruz Portland Cement Co. (common) ⁸	Apr. 24	50	85	91	\$1 quar. \$1 ex. Dec. 24
Superior Portland Cement, Inc. (new stock) ²⁰	Apr. 9	-----	44	44 1/2	-----
United States Gypsum Co. (common) ³	Apr. 25	20	142 1/4	143	2% quar. Mar. 31
United States Gypsum Co. (preferred).....	Apr. 27	100	114	115	1 3/4% quar. Mar. 31
Universal Gypsum Co. (common) ³	Apr. 28	No par	17	17 1/2	-----
Universal Gypsum V.T.C. ³	Apr. 28	No par	16 1/2	-----	-----
Universal Gypsum Co. (preferred) ³	Aug. 5	-----	76	-----	1 3/4% quar. Sept. 15
Universal Gypsum Co. (1st Mortgage 7% bonds) ³	Apr. 28	-----	99	(at 6 1/2%)	-----
Union Rock Co. (7% serial gold bonds) ¹⁸	Apr. 23	100	100	102	-----
Wabash Portland Cement Co. ¹	Aug. 3	50	60	100	-----
Wisconsin Lime and Cement Co. (1st Mort. 6s, 1940) ¹⁵	Apr. 27	100	98 1/2	100	-----
Wolverine Portland Cement Co.	Apr. 27	10	6	7	2% quar. Aug. 15

¹Quotations by Watling, Lerchen & Co., Detroit, Mich. ²Quotations by Bristol & Willett, New York. ³Quotations by True, Webber & Co., Chicago. ⁴Quotations by Butler, Beading & Co., Youngstown, Ohio. ⁵Quotations by Freeman, Smith & Camp Co., San Francisco, Calif. ⁶Quotations by Frederic H. Hatch & Co., New York. ⁷Quotations by F. M. Zeiler & Co., Chicago, Ill. ⁸Quotations by De Fremery & Co., San Francisco, Calif. ⁹Quotations by A. E. White Co., San Francisco, Calif. ¹⁰Quotations by Lee, Higginson & Co., Boston, Mass. ¹¹Nesbitt, Thomson & Co., Montreal, Canada. ¹²E. B. Merritt & Co., Inc., Bridgeport, Conn. ¹³Peters Trust Co., Omaha, Neb. ¹⁴Second Ward Securities Co., Milwaukee, Wis. ¹⁵Central Trust Co. of Illinois, Chicago. ¹⁶J. S. Wilson Jr. Co., Baltimore, Md. ¹⁷Chas. W. Scranton & Co., New Haven, Conn. ¹⁸Dean, Witter & Co., Los Angeles, Calif. ¹⁹Hemphill, Noyes & Co., New York. ²⁰Quotations by Bond & Goodwin & Tucker, Inc., San Francisco. ²¹Baker, Simonds & Co., Inc., New York. ²²William C. Simons, Inc., Springfield, Mass. ²³Blair & Co., New York and Chicago. ²⁴E. H. Rollins, Chicago, and A. D. Leach, Chicago.

Editorial Comment

The most recent statistics of the U. S. Bureau of Labor (March) show price declines in practically all commodities as compared with the previous month. The commodity price index showed a drop of $3\frac{1}{2}$ points—to 151.5, which is the lowest index figure in 18 months. The percentage of change in building materials prices was only 1 point (from February to March) as against an average of 2 points for all commodities. This downward trend of commodity prices in the face of very great industrial activity is considered significant by leading economists, and is looked upon as evidence of increasing competition to supply limited demand. It is unfortunate under such circumstances to witness one important element in the construction industry coming out to demand higher prices—that element is the building trades unions. Without the co-operation of this element in meeting the apparently universal demand for lower costs the building industry faces a serious problem.

“If state legislatures insist on levying a severance tax as a super-tax, then some return should be made for it, for taxes like other payments of money

Capital Waste Preventable? should be made only for value received. It may be suggested that one way by which the state could make return is to make the tax a license tax. License could then be refused where it could be shown that the market in any particular locality is already supplied with the products to be taxed at fair prices, based upon the cost of production. This would prevent unnecessary investment of capital. Licenses could be refused producers who do not work the ground cleanly and systematically. It is admitted that there has been a great deal of waste in the extraction of coal, oil, gas and metallic ores, and even of the products of rock quarries and sand pits. Because of unsystematic dredging and the practice of throwing part of the product back into the river, many parts of river beds which were once important sources of sand and gravel are now almost unworkable. This state of things has been brought about by unrestrained and unregulated competition. In a few rock products industries in some localities there are too many plants and no more should be built until demand has caught up with supply, except to replace worn out and obsolescent plants. If a severance tax can be made to prevent waste of capital investment and of natural resources, in a fair and equitable manner, there might be some reason for its existence.”

The foregoing was written by a correspondent in connection with the editorial on the severance tax which appeared in the April 3 issue. It is worth thinking about, because it presents a definite method of solving a problem which is beginning to call for a solution, in the rock products industry.

Many wastes in industry have at least been partially checked by voluntary adoption of trade standards, by improving business ethics, by co-operative research to cheapen processes and conserve labor and materials. There is still one immense waste that no organized attempt has been made to check, and that is the waste of capital in unnecessary and superfluous producing units. Capital conservation is just as essential to our public welfare as is the prevention of waste in labor and materials, for the use of capital to build unnecessary producing units not only jeopardizes the capital of unintelligent people who furnish it, but the capital already invested by competent business men, who under present conditions are helpless to save either themselves or their industry from the blighting effects of price wars and savage competition for the survival of the fittest.

Our own idea is that in some way the men engaged in the industries may eventually be able to control legitimately the investment of capital in these industries, since they are in the best position to judge whether new plants are needed or not.

The power to prevent the establishment of new plants could be tremendously abused, and it may be utopian to believe it ever could be exercised equitably by men whose interests are, and are always likely to be, primarily selfish. Nevertheless many business men are beginning to realize more and more that that “enlightened selfishness”—a point of view large enough to take in established economic and moral laws—is much more satisfactory, and ultimately more profitable than the code of “get all you can while the getting is good.” Common sense and a knowledge of industry in general—of the growing competition between industries rather than between individuals—ought to be enough to insure an equitable administration of any device to limit new competition, as well as to regulate competition.

It is an opportunity that beckons to intelligent, quiet, earnest business men—men who have the welfare of their communities and of their country more sincerely at heart than many blatant politicians. It is more than an opportunity, it is a challenge to their integrity and their ability to govern industry for the public welfare, as well as for their own private interests.

QUOTATIONS OF INACTIVE ROCK PRODUCTS SECURITIES

Stock	Date	Par	Price bid	Price asked	Divided rate
Coplay Cement Mfg. Co. (common) ⁽⁴⁾	Dec. 16	-----	12½	-----	
Coplay Cement Mfg. Co. (preferred) ⁽¹⁾	Dec. 30	-----	70	-----	
Eastern Brick Corp. 7% cu. pfd. ⁽¹⁾	Dec. 9	10	40c	-----	
Eastern Brick Corp. (sand lime brick) (common) ⁽¹⁾	Dec. 9	10	40c	-----	
Edison Portland Cement Co. (common)	Nov. 3	50	7½c(x)	-----	
Iroquois Sand & Gravel Co., Ltd. (2 sh. com. and 3 sh. pfd.) ⁽¹⁾	Mar. 17	-----	\$12 for the lot	-----	
Edison Portland Cement Co. (preferred)	Nov. 3	50	17½c(x)	-----	
Lime and Stone Products Co. (1100 sh. pfd., \$10 par and 700 sh. com., \$10 par)	Feb. 10	-----	\$66 for the lot	-----	
Missouri Portland Cement Co. (serial bonds)	Dec. 31	-----	104¾	104¾	¾ % semi-annual
Olympic Portland Cement Co. (g)	Oct. 13	-----	-----	£1½	
Phosphate Mining Co. ⁽¹⁾	Nov. 25	-----	1@5	-----	
Pittsfield Lime and Stone Co. (preferred)	-----	100	-----	-----	2% quar. Apr. 1
Rock Plaster Corp. (390 sh. com., no par) ⁽¹⁾	Mar. 17	-----	\$12 for the lot	-----	
Simbroco Stone Co. (pfd.)	Dec. 12	-----	-----	-----	\$2 Jan. 1
Tidewater Portland Cement Co. (common) ⁽²⁾	Nov. 25	-----	8½	-----	
Vermont Milling Products Co. (slate granules) 5 sh. pfd. and 1 sh. com. ⁽²⁾	Dec. 30	-----	\$1 for the lot	-----	
Winchester Brick Co. (preferred) (sand lime brick) ⁽⁵⁾	Dec. 16	-----	10c	-----	

(g) Neidecker and Co., Ltd., London, England. ⁽¹⁾ Price obtained at auction by Adrian H. Muller & Sons, New York. ⁽²⁾ Price obtained at auction by R. L. Day and Co., Boston. ⁽³⁾ Price obtained at auction by Weilepp-Bruton and Co., Baltimore, Md. ⁽⁴⁾ Price obtained at auction by Barnes and Lofland, Philadelphia, Pa. ⁽⁵⁾ Price obtained at auction for lot of 50 shares by R. L. Day and Co., Boston, Mass. (x) Price obtained at auction by Barnes and Lofland, Philadelphia, on November 3, 1925.

New Egyptian Portland Preferred Offered

BAKER, SIMONDS AND CO., New York and Detroit, are offering at 100, \$600,000 7% cumulative preferred stock (with stock purchase warrants).

Free of normal federal income tax. Dividends payable Q.-J. (first payment April 1, 1926). Redeemable all or part at 110 and dividends before January 1, 1930; at 107.50 and dividends from January 1, 1930 to January 1, 1935; at 105 and dividends after January 1, 1935. Transfer agent, Detroit Trust Co., Detroit. Registrar, Security Trust Co., Detroit.

Capitalization	Authorized	Outstanding
5½% general and refunding bonds, 1926-33	\$600,000	\$475,000
7% preferred stock (par \$100)	1,200,000	600,000
Common stock (no par value)	150,000 shs.	88,700 shs.

There are reserved in the treasury 30,000 shares of no par common stock to provide for exercising of stock purchase warrants.

The following data have been compiled from a letter of Maynard D. Smith, president of the company:

Company.—Incorporated in Michigan in 1914, with one cement plant at Fenton, Mich. In 1919 the present management took charge, and steadily expanded operations so that in 1923 a modern plant was built at Port Huron, Mich. Production has increased steadily from 147,000 bbl. in 1919 to over 1,150,000 bbl. in 1925. Through equipment installed in 1925 productive capacity in 1926 should be in excess of 1,550,000 bbl.

Earnings.—Gross business and profits have grown steadily under the present management. The following table indicates the growth of the company during the last few years:

Year	Sales	*Net	Present Pref. Dividends Required	Times Earned
1923	1,097,432	98,559	42,000	2.3
1924	2,244,806	144,439	42,000	3.4
1925	2,391,991	171,366	42,000	4.0
1926 (est.)	3,500,000	350,000	42,000	8.3

*Net profits after all expenses, interest and federal taxes.

Net earnings of \$171,366 available for preferred dividends in 1925 were over four times dividend requirements on the preferred stock to be presently outstanding and estimated net earnings of \$350,000 for 1926 would be over eight times dividend requirements.

Stock Purchase Warrants.—Each share of 7% preferred stock will be accompanied by a stock purchase warrant, entitling the holder to purchase from the company five shares of no par common stock at the following prices: From July 1, 1926 to July 1, 1927, at \$20 per share; from July 1, 1927 to July 1, 1928, at \$22.50 per share; from July 1, 1928 to July 1, 1929, at \$25 per share.—*Financial Chronicle.*

Consolidated Sand Company (Canada) Preferred Stock Offered

EQUITABLE SECURITIES CORP., LTD., and Johnston and Ward, Montreal, are offering \$415,000 7% cumulative redeemable, sinking fund, first preferred stock of the Consolidated Sand Co., Ltd., Montreal, Que., at par (\$100) and dividends, with bonus of one-quarter share of no par value common stock with every share of preferred.

Dividends accrue from April 1, 1926, and are payable quarterly in Canadian funds or to bona fide residents of the United States in U. S. funds. Callable, all or part, at \$110 and dividends, upon 30 days' notice. Transfer agents, Montreal Trust Co.

The following information is taken from the brokers' prospectus:

CAPITALIZATION	Authorized	Issued
7% cum. red. sinking fund	8,000 shs	5,000 shs
1st pref. stock	\$500,000	\$415,000
Common stock (no par value)	8,000 shs	5,000 shs

Company.—Controls practically all the available washed sand in commercial quantities within 150 miles of Montreal and handles about 75% of this sand used for building purposes in Montreal and the vicinity. Company represents a growth of 15 years and is a consolidation of the three leading sand companies in Montreal. Through ownership in fee simple and long term leases from the Quebec government of 693 acres of the bed of the Lake of Two Mountains, and 127 acres at the mouth of the St. Maurice river, company controls what is to all intents and purposes an inexhaustible supply of the finest grade of river sand.

In addition the company has a fleet of 28 tugs, barges, scows, floating cranes and pump scows, and two large discharging and distributing plants at Wellington street and Ottawa street on the Lachine canal with all the necessary equipment for handling and distributing the sand as it is brought from the Lake of Two Mountains and Three Rivers.

Earnings.—Average net operating profit

for three years and eight months ended December 31, 1925, after operating expenses, including maintenance, repairs and depreciation amounted to \$60,735 annually. This is equal to over twice the preferred dividend requirements and \$5.70 a share on the outstanding common stock, after providing for sinking fund requirements on the preferred shares. The sales of sand and earnings for 1925 were the largest in the history of the company, and net operating profits amounted to \$67,990 or nearly two and one-half times preferred dividend requirements, and \$7 a share on the common stock, after allowing for the sinking fund.

Sinking Fund.—Charter provides for an annual sinking fund of 10% of the net earnings, after payment of dividends on the first preferred stock. This fund will be used for the purchase in the open market or by lot at prices not exceeding the redemption price of preferred shares which shares so purchased shall be cancelled.

Consolidated Cement 5-Year Gold Notes Offered

A. B. LEACH & CO., INC., Chicago, Ill., are offering at 100 and interest, \$1,110,000 6½% sinking fund convertible gold notes of the Consolidated Cement Corp. The notes, of \$500 and \$1000 denominations, are dated March 1, 1926, and due March 1, 1931, and are convertible during their life into 10 shares of 7% cumulative preferred stock and two shares of common stock for each \$1000 of the notes converted.

North American Cement First Quarter Earnings

THE net earnings for the first quarter of 1926 of the North American Cement Corp. were \$105,478 after depreciation and depletion, but before interest, amortization and federal taxes.—*Chicago (Ill.) Tribune.*

New Egyptian Portland Bonds Offered

BAKER, SIMONDS & CO., INC., New York and Detroit, are offering at prices to yield from 6% to 6.40%, according to maturity, \$475,000 5½% general and refunding (now first) mortgage bonds of the New Egyptian Portland Cement Co., Detroit, Mich. Dated May 10, 1923; due serially Nov. 10, 1927-33. This issue does not represent new financing.

Warns Against Over-Production of Cement in South

THE Birmingham district and the South in general is in prosperous condition, apparently, according to H. C. Koch, vice-president of the International Cement Corp. of New York, who was recently in Birmingham on a tour of inspection. The Alabama Portland Cement Co., a subsidiary of the International, is located at North Birmingham.

"The capacity of cement mills in the South is about in balance with total consumption," said Mr. Koch. "Add to this the cement shipped in by mills in adjacent states who look upon the South as a natural market and the available supply is considerably in excess of consumption. With a number of new plants coming into operation and those projected for completion during 1926-27, the

South will be called upon to absorb an additional capacity of approximately 6,000,000 bbl. This will mean a productive capacity of about 35% in excess of consumption.

"The cement industry, as a whole, is in a healthy condition. Due to what is perhaps the most effective organized effort in the history of the industry to promote the use of a product, cement consumption is increasing at a satisfactory rate. But any localized condition where production is increasing out of relation to consumption must be watched carefully to avoid the repetition of a condition such as the cement industry went through during the period of 1910-1915, when 30 or more companies passed into financial troubles."

Mr. Koch said further that the basis for continued good business in the cement industry exists but cautioned against overproduction.—*Birmingham (Ala.) News.*

Progress on Lime Plant of New England Lime and Portland Cement Company

Expect to Operate in July

PRESIDENT ALFRED S. BLACK has supplied the following data and the accompanying views of progress on his new lime plant at Thomaston and Rockland, Maine:

"The lime unit will go into production not later than July, 1926. Both plant-layout and equipment closely follow the lines of the latest conservative thought as to the best practices applicable to lime manufacture in all its phases.

"While the plant is thoroughly modern, the company has carefully avoided in its plans and construction such things as might be classed as purely experimental. It has adhered carefully to such improvements as are generally recognized in the industry as being highly desirable for efficiency in manufacturing a quality product, and are often impossible to obtain in any other than a complete new plant.

"The plant when complete will include a thoroughly modern portland cement mill with an initial capacity of 3000 bbl. a day, together with a lime unit, the first section of which will include four Schaffer semi-automatic shaft kilns, with an annual capacity of 500,000 bbl. of burned lump lime per year. The first two of these kilns are being completed in time for operation in July with the other two to follow immediately.

"The quarry from which rock for both lime and cement will be taken consists of some 500,000,000 cu. ft. of limestone suitable for the manufacture of portland

cement and available for open quarry methods of recovery, together with some 650,000,000 cu. ft. of stone underground particularly adapted to recovery by mining methods. All of this stone has been proven both as to quantity and character by diamond drill cores and laboratory analyses of a most extensive character. There is a further quantity of available limestone which undoubtedly exists, but has not been core drilled.

"This limestone is in what is known geologically as the Rockland formation and in referring to it the United States Geological Survey says, 'It may be borne in mind that no where on this (the Atlantic) coast south of Rockland do pure low magnesia limestones occur near the seaboard.' This company's properties are directly on the seaboard and being approximately 1000 acres in extent cover all of the known or probable limestone area in the formation that has not previously been operated. There is a deposit of marine clay on and directly adjacent to the rock deposit. The company owns over 20 acres of land on the Rockland waterfront and close proximity to the supply of raw gypsum from Canadian sources by water shipment, as well as tidewater fuel supplies.

"Included in the limestone deposit is high-calcium limestone, suitable for the manufacture of high quality finishing lime. While operating in connection with the cement unit, on which construction will be started by the time the lime plant

is completed, it is practicable to so carefully select the highest grade of limestone as to assure the production of only the very best of finishing lime. It is the company's purpose to so operate.

Lime Plant

"The kilns are of the Schaffer semi-automatic shaft type with an outside diameter of 17 ft. 3 in. and a height from firing floor to the top of the charging chamber of 53 ft. Each kiln has four furnaces fired by automatic stokers of a special design.

"A recent improvement on the charging mechanism of the Schaffer kiln is installed in this plant for the first time, in the form of counter-balanced doors in the top of the kiln, which drop when the stone is dumped on them and automatically close as the stone slides down into the kiln. This is designed to break the fall of the stone, and to improve its distribution, as well as insure a closed top on the kilns at all times, and to provide for the proper functioning of the kiln stacks to maintain a constant draft of whatever degree is required for best burning conditions.

"To resist abrasion inside the charging chamber and reduce the shock of falling stone, the kilns are lined for a distance of 22 ft. down from the top with a hard-burned, shale brick, and further protected by steel railroad rails spaced 8 in. apart extending up and down inside of the lining, supported from the top of the kiln, and spaced with cast iron spacers between the rails to assure their retaining a permanent fixed position. This is a new feature of kiln development.

"Crushed coal is dumped from hopper-bottom cars through a track hopper and crushed in the usual way, then conveyed by an incline scraper conveyor to a conical pile holding 2500 tons stored in the open adjacent to the quarry and kilns.

"A standard type of reclaiming machinery in the form of a belt conveyor operating through a tunnel extending under the coal pile carries the coal into a chute which discharges above the quarry floor, about 45 ft. below the general plant yard level. This chute empties into a hopper from which the ordinary quarry cars are loaded with coal and moved over the quarry tracks and up the incline to the top of the kilns in a manner exactly similar to and on the same transportation system as the stone used to charge the kilns.

"Between the No. 1 and the No. 2 kiln a steel bunker extending from the top of the kilns down to a height of about 15 ft. above the firing floor is constructed, using the steel kiln as two sides of the bunker and with flat plates extending from the center line of one kiln to the center line of the adjacent kiln tangent to the kiln shells, thus forming between the kilns a



Panorama of the quarry of the New England Lime and Portland Cement Co.

coal bunker with a capacity of 75 tons. The coal is discharged into this bunker from the same track as is used in stone charging, through iron doors on the top of the bunker between the kilns.

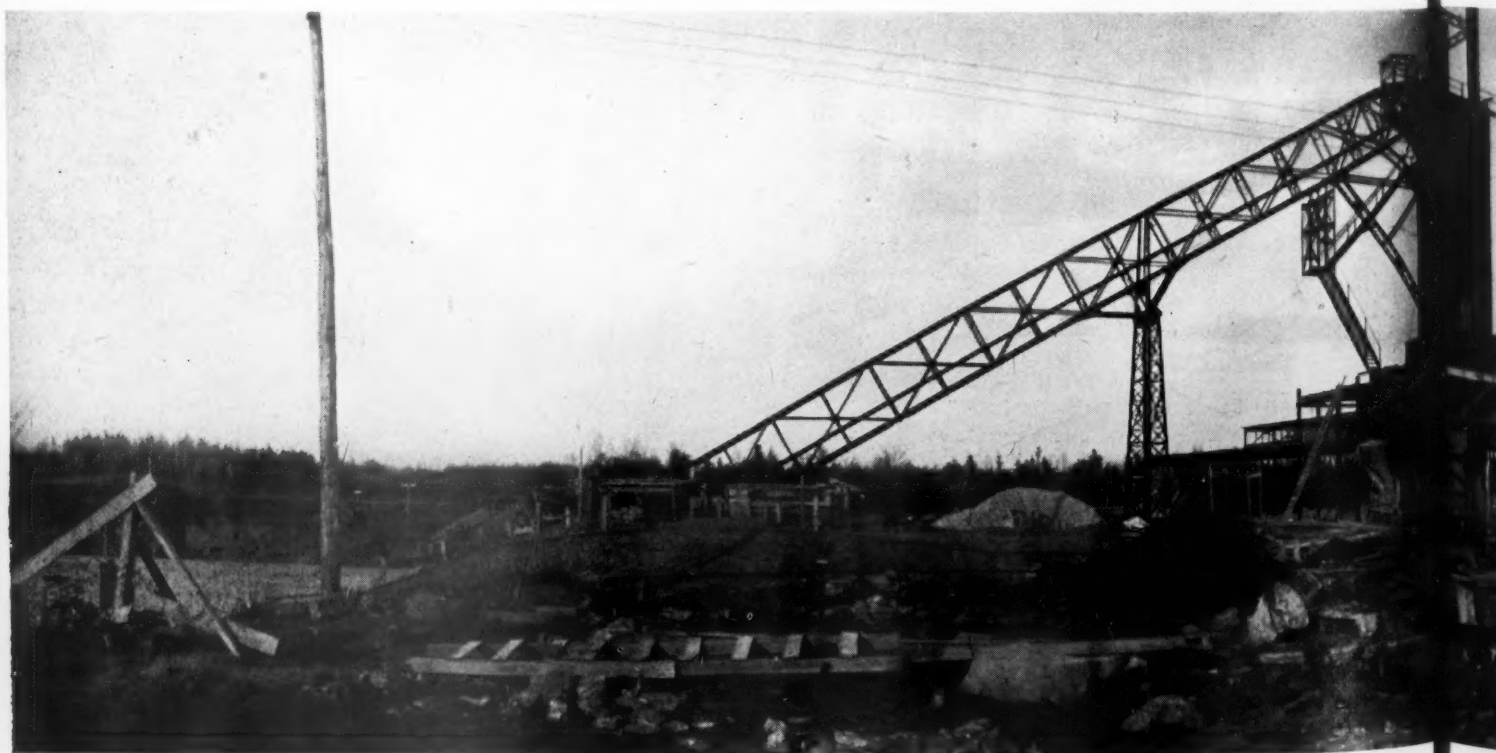
"Danger of combustion in this bunker

is prevented by insulation, and yet it is expected that the temperature will be sufficiently high to prevent the freezing of wet coal in severe weather.

"From the coal bunker the stokers are fed by weigh-lorries, running on tracks

above the stoker feed hoppers. The fuel consumed will be measured by volume in these weigh-lorries.

"The lime when discharged from the coolers will be sorted by hand, as this is believed by the company to be the only



First unit of the new lime plant of the New England Lime and Portland Cement Co.



Portland Cement Co. quarry at Thomaston, Me., showing development work

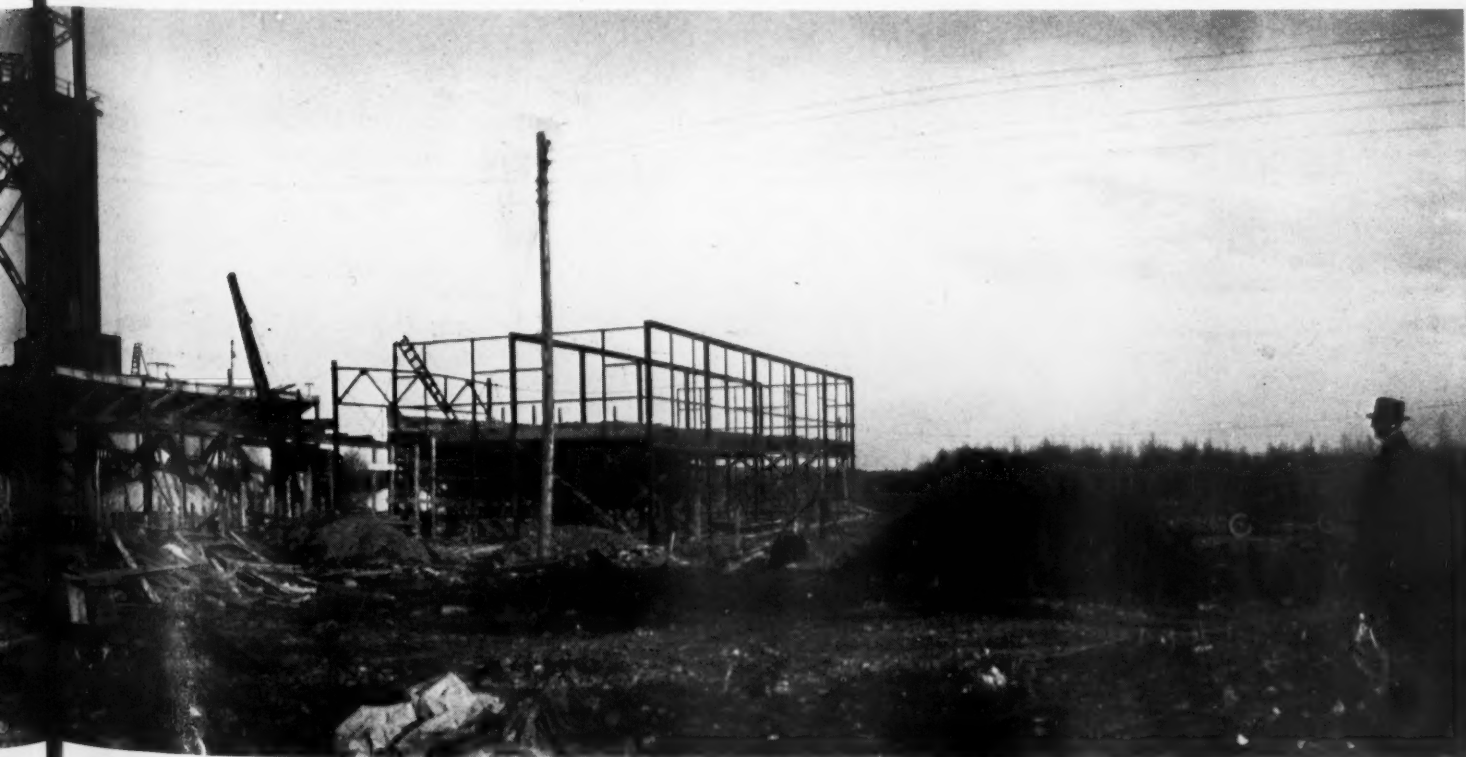
positive way of assuring proper selection. The most modern methods of barrel handling will be used and a Schaffer hydrate plant of the latest type will form a part of the plant.

"The quarry development at the pres-

ent time has proceeded to a point where a vertical face of high-grade stone, 35 ft. high and approximately 1000 ft. long, is exposed ready to be shot down and transported to the kilns."

The officers of the company are as fol-

lows: Alfred S. Black, president; Walter E. Bowe, treasurer; H. A. Mintz, secretary, and W. R. Phillips, vice-president and general manager, in charge of construction of the new plant and he will have charge of operation.



Lime Island Cement Co., showing progress of construction work to date

Leathem D. Smith Stone Company Prepares for Busy Season

WITH many large orders for crushed stone and other stone products, the quarry and crushing plant of the Leathem D. Smith Stone Co., Sturgeon Bay, Wis., has begun the season's operation. It is said that orders on hand for concrete aggregate and rip rap will keep the plant running to capacity throughout the entire season. The rip rap is for the large breakwaters under construction near Milwaukee and other places along the Great Lakes. The plant, which was described in *Rock Products*, June 2 issue, is regarded as a very efficient operation, producing about 2500 tons per 10-hour day. A unique system of design allows for the installation of additional equipment and the speeding up of conveyor systems so that a capacity of 10,000 tons may be obtained. A large tunnel conveyor for handling crushed stone screenings and additional storage tunnels will be built within a short time.

For making lake deliveries the company operates a fleet of three large carriers. The steamer Andast, one of the largest, was recently damaged through fire and will be put in condition as soon as possible. The Fontana has a capacity of 6000 tons and the recently chartered Kennedy has about the same capacity. The Bay State, which was formerly used to carry stone, is now being converted so that it can be used to haul sand. It is being equipped with a type of unloader patented by L. D. Smith, president of the company, which is especially designed for handling sand, after which it will be taken to Lake Erie to engage in the sand industry.

The officers of the company are: Leathem D. Smith, president, who designed and supervised the construction of the plant; G. H. Smith, vice-president; Frank H. Behringer, secretary-treasurer, and Fred Lau, general superintendent.—*Green Bay (Wis.) Gazette*.

Accidents Cut 45 Per Cent by Cement Makers Since 1920

WHAT accident prevention experts believe is a record in the reduction of industrial accidents was announced recently by William M. Kinney, general manager of the Portland Cement Association, with the statement that since 1920 the "safety first" activities carried on by his organization have reduced the number of accidents in portland cement mills 45.2%, the number of days lost due to accidents 40%, and the number of fatalities 33.3%.

"These records," explained Mr. Kinney, "apply to the whole industry, which employs more than 40,000 workers. Individual plants far exceeded these figures, however.

Plant No. 8 of the Canada Cement Co. at Port Colborne, Ontario, and the Duluth, Minnesota, plant of the Universal Portland Cement Co., each ran practically a year and a half without a single lost-time accident. Two men from each of these plants will be sent to the spring meeting of our association in New York City to receive the Portland Cement Association's safety trophy.

"When our members began this safety work thirteen years ago they found to their surprise that the responsibility for accidents lay about 25% with the manufacturers, and about 75% with the men themselves. In many plants, our investigators learned, the machinery itself was dangerous. But the men themselves, either through ignorance or recklessness, were far more dangerous. They took chances constantly that were contrary to ordinary reason.

"We quickly induced our members to protect their machinery, and then we began an intensive campaign among the workers. The cement makers undertook all this work with the idea that they were simply spending money for their employees, but they quickly found that it paid them in actual dollars and cents, through improvement of their manufacturing personnel, reduction in delays and savings in accident compensation."

Missouri Changes Specifications for Highway Cement

F. V. REAGEL, engineer of materials for the Missouri State Highway Commission, writes to the *Engineering News-Record* (April 22) relative to the change in cement specifications made by the Missouri State Highway Commission early in 1926. These changes (1) called for a minimum tensile strength requirement of 225 lb. in 7 days and (2) added a provision that fluctuations in setting time causing finish difficulties in the field would be held cause for rejection.

It will be remembered that three of the large cement companies refused to bid under the revised specifications on the ground that the entire structure of cement standardization would be upset by the adoption of other than the standard specification, although these dissenting companies offered to furnish cement better than that called for by the revised specifications.

Mr. Reagel writes that while the Missouri Highway Commission was in sympathy with standardization, it was of the opinion that no national agency is responsible for the quality of the work done in Missouri and that the state could not afford to wait for relief from the action of national agencies. They felt the only sound procedure was to establish specifications so that the highest safe quality compatible with general economic production would be secured. It would be a poor policy to specify a quality much inferior to the general quality economically available. Graphs in the article showed that the commission found

itself in the latter position in respect to the product of nine mills furnishing nearly two million barrels of cement in 1925.

The highway commission has found it necessary in an increasing number of instances to open highways to traffic in a week or ten days, or under the normal curing period, owing to the increased density of traffic which is another argument for the use of an improved quality of cement.

In concluding, Mr. Reagel points out that the cement industry has kept pace to no small degree with the needs of the engineer and says that there has been a wonderful improvement in quality as shown by the test records. But the specifications remain on the old basis, preventing designers from taking advantage of the increased quality available, because of the isolated case in which on inferior product must be accepted. Utilization of the better quality of cement available will enable the engineer to design with greater economy and to route traffic over new work at the earliest possible time.

Gypsum Wall Board Shipment Made to New Zealand

INDICATIVE of increased foreign trade, 650,000 sq. ft. of wall board, with a valuation of approximately \$20,000, were shipped to New Zealand recently by the Schumacher Wall Board Corp.

According to Mr. Schumacher, the material, which is representative of several other large shipments made to foreign countries in recent months, will be used for general building purposes throughout the islands. He explained that the wall board was especially packed in extra heavy wooden crates for the voyage across the ocean.—*Los Angeles (Calif.) Examiner*.

Reno Gravel Companies Merge Interests

ANNOUNCEMENT has been recently made of the merger of the Smith and Peterson Co. with F. M. Frandsen, both of Reno, Nev., and who are said to supply nearly all of the crushed stone, sand and gravel used in construction and road work in Reno. The two plants, valued at about \$125,000, will be combined under one head. The Frandsen plant is located east of Reno and the Smith and Peterson plant lies on the west of the city.—*Reno (Nev.) State-Journal*.

Correction

IN the story of the Blackwater Stone Co.'s plant, published in the March 20 issue, Charles Briney was named as the plant superintendent. This was an error, for W. J. Brimacombe is the superintendent of this plant located at Blackwater, Mo., and Mr. Briney is superintendent of the McDowell, Mo., plant.

Cement Products

TRADE MARK REGISTERED WITH U. S. PATENT OFFICE

Making Cement Blocks with a Curing Compound

A Florida Inventor Starts a Block Plant to Use His Own Product

"PETRINITE" is a compound for hardening concrete. There are several compounds for similar purposes on the market, "Cal" and calcium chloride probably being the best known. The formula of "Petrinite" was not given but the literature of the company making it says that its action is to fill

the voids of the concrete with crystals of calcium carbonate, so it is presumably a lime compound. The inventor of "Petrinite" is George M. Formby, of Jacksonville, Fla., and to introduce the product he started a cement block plant in Jacksonville. This is managed by Miss Mannie D. Brown, who

is financially interested in "Petrinite" as well as the block business.

Whatever the merits of the hardening compound used, there is no denying that the plant makes an excellent block. The absorption was stated to be 2.9% and the resistance to compression must be high as the block is



The plant, which is on the outskirts of Jacksonville, Fla. Right—The curing yard and curing shed. At the time the plant was visited blocks were being delivered about as fast as they could be made



Left—In the curing sheds the blocks are placed on 2x4 timbers set on edge and supported by cured blocks. This is to allow a circulation of air around them. Right—The peculiar mixer used which has two horizontal blades rotated in a flat pan

very hard and dense in appearance.

A much better grade of aggregate is used than that generally used in the Florida block plants that were seen. On the day that the plant was visited the aggregates used were Chattahoochee sand and crushed granite from Columbia, S. C. Only lean mixes are used for it is stated that "Petrinite" will not work except in a lean mix. From 18 to 24 blocks, 8x8x16-in. in size, are made from one sack of cement. The mix is varied according to the kind of aggregate used and its grading. On the day the plant was visited the mix was stated to be 1:5:8.

The mechanical arrangements of this plant are simple but effective enough. The aggregate is measured into wheelbarrows and wheeled to the mixer which is of Mr. Formby's design and is quite novel. It consists of a flat pan about 6 ft. in diameter and perhaps 18 in. deep. There is a center shaft in this pan on which are two curved blades. These turn the mix and work it in and out from the center as the shaft revolves. A long period of mixing is given, five minutes at least. The mixer is run by a gasoline engine.

The blocks are formed in an Anchor machine and removed by hand to the curing racks. Cast iron pallets are used. The pallets are placed across 4x4-in. sticks held on blocks so as to admit a free circulation of air all around the block.

The hardening is rapid and the blocks are removed to the yard after a short stay in the curing shed. No steam is used. In 48 hours they may be placed in the wall, as with the use of the hardening compound the strength in 48 hours is said to be equal to ordinary concrete in seven days.

Some very pretty faced block are made. One facing much liked is of coquina, the famous shell rock which has been so much used for building and road making in Florida. Another facing which is called "Pablo" is of loose shells which are found in great quantities on some of the beaches near Jacksonville.

Whether curing compounds may be profitably used or not in the manufacture of cement blocks has been considerably discussed by block men. In most cases such compounds are not used. The main interest in the foregoing article is that it described a plant which regularly uses a curing compound and is commercially successful.

Berkshire Gravel Company Operates Large Cement Products Plant

IN addition to producing gravel at their plant at Lenoxdale, Mass., the Berkshire Gravel Co. makes good use of the screenings from the excavations of the deposit worked at Willow Mountain. These screenings, which are mostly sand, comprise about 25% of the diggings and are used in the manufacture of Shope brick.

The company operates a modern plant all run by electricity and which produces from 10,000 to 15,000 vari-colored Shope brick per day. The sand is hauled from the screening plant to the brick plant by White trucks, which are also used to make deliveries of the finished brick to the markets.

Florida Cement Products Plant to Use Cement Gun Process

CONSTRUCTION of the two-unit cement gun plant now being built on the Isle of Normandy, Fla., will soon be completed, Duncan E. Rossetter, engineer for the Normandy Beach Properties, announced recently.

The plant is being built for production of steel piles and concrete slabs to be used in the concrete sea-wall which will surround the Isle of Normandy.

Production of concrete slabs is expected to start as soon as the plant is completed.

Total cost of the plant will be \$25,000 when machinery and casts are installed.—*Miami (Fla.) Herald.*

A \$1,000,000 Deal in Cement Pipe Plants

SALE of the Little Rock, Ark., and Dallas, Texas, plants of the Shearman Concrete Pipe Co. to R. S. Lander, secretary-treasurer of the firm, by A. N. Shearman of Knoxville, Tenn., for a reported consideration of \$1,000,000, has been completed, according to an announcement in the *Little Rock (Ark.) Gazette.*

Plans for doubling the capacity of the two plants and the installation of additional machinery to cost approximately \$100,000 were announced by Mr. Lander, who will continue to manage both factories with no change in the firm name. The improvements probably will be made this summer, it was said.

A rapid development in the growth of business of the pipe company which manufactures concrete pipe for sewerage, drainage and culvert purposes has made expansion of the plants' capacities necessary, Mr. Lander said. The Little Rock plant was established in 1920, and during the past several years its volume of business has doubled annually. The Dallas factory was built in 1925 by Mr. Lander.

Both plants have an output of about six cars of pipe daily, the diameter of the pipes ranging from 4 to 54 in. The factory at Little Rock employs 25 men and serves a territory embracing Arkansas, Missouri, Oklahoma and Louisiana. It is the only plant of its kind in the state and was erected by Lander following his association with Shearman at Knoxville.

The outright purchase of the factories by Mr. Lander from Mr. Shearman, former president of the concern, is a sequel to the sale of Shearman plants east of the Mississippi for \$2,000,000 last February.



Left—The block machine used with its cast iron pallets. Right—The tallest pile is of blocks faced with coquina, the next in height of blocks with "Pablo" facing

German Precast Houses Said to Be Erected in One Day

System Used on Large Scale

THE photographs that accompany this were taken in a residential section of Berlin, Germany, and show the erection of the precast house which has been devised there to help in solving the problem of a housing shortage. Similar precast houses have been erected in other European countries, notably in Holland.

To judge by the pictures and the descriptions of the method which have appeared in European papers, the method would hardly be profitable unless a number of houses or apartments of substantially the same design were to be erected. As in all cast products whether of concrete or other material, the greater part of the first cost is in the molds and in

the preparations that have to be made to handle the cast pieces quickly and easily.

In this method, first a level surface has to be carefully prepared for the molds. Door frames and window frames are cast into the panels as they come. Concrete is mixed by a machine, poured, tamped and finished apparently after the manner of making a road slab for a concrete highway. It is said that one day is sufficient to erect a house after the unit has hardened.

The method of handling the slabs shown here is by the use of a traveling crane which runs on two tracks, one on either side of the building to be erected. The slabs are lifted by chains and hooks

which fasten into eyes cast in the edge of the slab. One picture shows a slab with a door opening, and the door frame in place, being lifted from the mold and another picture shows the same slab being swung into place on the foundation. The foundations of such houses may be either of precast units or poured.

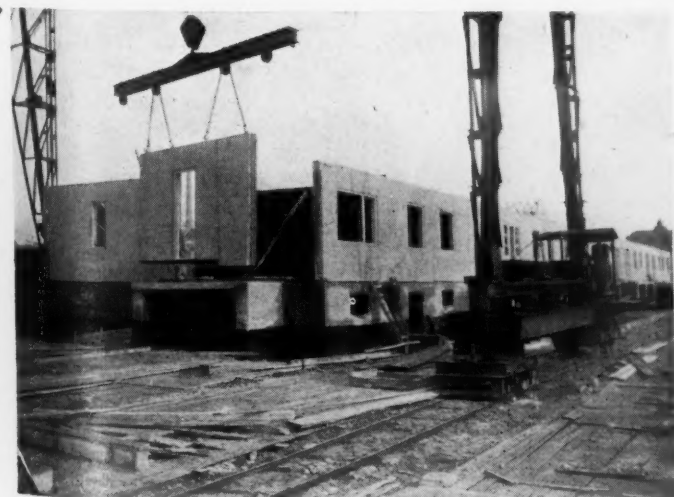
In the United States some work of the kind has been attempted especially in the construction of warehouses. In one instance an ordinary locomotive crane, electrically powered, was used to lift the precast slabs into position.

For ordinary residence and warehouse construction there would seem to be little probability that the precast slab will displace the cement block. It is only in those cases where a great many slabs are to be handled that it would pay to go to the expense of rigging up for the work.

In some of the European houses made of precast slabs special aggregates have been used to lessen the weight of the structure. Cinders have been much used for this purpose.



Left—Casting the wall slabs. Note the door and window openings with the frames in place. The two men at the right of the mixer are spreading concrete which has just been poured. Right—Lifting a slab with a door frame from the molds by means of the traveling crane. The slab is lifted by four eyes cast in the upper edge



Left—The slab lifted from the mold is transported and swung at right angles to be placed on the foundation. The crane runs on tracks on both sides of the line of houses to be built. Right—Part of the row of houses with the walls erected and the rafters ready for the roof. All photos copyright by the Gilliams Service, 32 Union Square E., New York

Traffic and Transportation

EDWIN BROOKER, Consulting Transportation and Traffic Expert
Munsey Building, Washington, D. C.

Proposed Changes in Rates

THE following are the latest proposed changes in freight rates up to the week beginning April 26:

Central Freight Association Docket

To—	Present	Proposed
Dixon, Ohio	Per 100 lb. \$1.15	Per N. T. \$1.00
Mansfield, Ohio	16	1.20
Lancaster, Ohio	16	1.15

12985. **Crushed stone**, carloads, Greencastle, Ind., to Decatur, Ind. Present rate, 18½ cents (sixth class); proposed, \$1.26 per net ton for N. Y. C. & St. L. (C. L. Dist) delivery.

12987. **Crushed stone**, carloads, Melvin, Ohio, to Sardinia, Macon, Winchester and Seaman, Ohio. Present rate, \$1.10 per net ton to Sardinia and Macon, Ohio, per B. & O. Tariff H-3336-A, Ohio W. L. 2728; 17 cents (sixth class) to Winchester and Seaman, Ohio, per Agent B. T. Jones' Tariff I. C. C. 941, Ohio 739; proposed, \$1 per net ton.

12988. **Crushed stone**, carloads, Monon, Ind., to Virgie, Ind. (distance 31 miles), and Eniman, Ind. (distance 34 miles); Dunns, Ind. (distance 41 miles), and Burkes, Ind. (distance 40 miles). Present rates, to Virgie and Eniman, Ind., 97 cents per net ton; to Dunns, Ind., class rate, and to Burkes, Ind., \$1.07 per net ton. Proposed, to Virgie and Eniman, Ind., 80 cents per net ton; to Dunns and Burkes, Ind., \$1 per net ton.

12989. **Sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica), carloads, Cleveland, Ohio, to Wellington, Ohio. Present rate, 80 cents per net ton per N. Y. C. I. C. C. L. S. 1307; proposed, 70 cents per net ton when loaded in open top cars.

12990. **Crushed stone**, carloads, Narlo, Ohio, to Norwalk, Ohio (distance 33 miles). Present rate, 80 cents per net ton per N. Y. C. & St. L. R. R., I. C. C. N. K. P. 4602; proposed, 75 cents per net ton.

12994 (cancels D. A. 12953). **Gravel and sand**, except blast, engine, foundry, glass, loam, marl, molding and silica, carloads, Macksville, Ind., to Greenup, Ill. Present rate, 84 cents per net ton per P. R. R. Tariff I. C. C. F-1827; proposed, 76 cents per net ton.

13003. **Crushed stone**, carloads, Kenton, Ohio, to Cleveland, Ohio (distance via N. Y. C. & St. L. 142 miles). Present rate, sixth class per Jones' Freight Tariff 230, I. C. C. 940; proposed, \$1 per net ton.

13009. **Lime**, common, hydrated, quick or slaked, carloads, Durbin and Cold Springs, Ohio, to Farmersville and Germantown, Ohio. Present rate, 9 cents per C. C. C. St. L. Tariff 1533-K, I. C. C. 8204, Ohio No. 2564; proposed, 7½ cents.

13012. **Crushed stone**, carloads, Waterville, Ohio, to Pettisville, Archbold, Stryker and Bryan, Ohio. Present rate, 90 cents per net ton, as per N. Y. C. St. L. I. C. C. CL-924; proposed, \$1 per net ton.

13018. (2). **Rip rap or scrap stone**, carloads, McDermott, Ohio, to Golconda, Ill. Present rate, 28 cents (sixth class); proposed, \$2.80 per net ton.

13020. **Crushed stone**, in bulk, in open top cars, carloads, Piqua, Ohio, to Lancaster and Logan, Ohio. Present rate, 16 cents to Lancaster and 17 cents to Logan, Ohio, per C. F. A. Lines' Trf. 231, I. C. C. 941 proposed, \$1.20 per net ton.

13027. **Crushed stone and screenings**, carloads, Ellwood Junction, Hillsville and Walford, Penn., to Gould Colliery, Penn. Present rate, 16½ cents (6th class); proposed, \$1.05 per ton of 2000 lb.

13028. **Crushed stone**, carloads, Perkins Spur, Ind., to Boswell, Ind. Present rate, 98 cents per net ton; proposed, 88 cents per net ton.

13029. **Crushed stone**, carloads, Putnamville, Ind., to point in Indiana.

To	Cents per ton
Hoosier, Ind.	101
Linton, Ind.	101
Jasonville, Ind.	95

Present rates, class rates.

13030. **Sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica), and gravel, carloads,

La Fayette, Ind., to Auburn, Beechley, Calloway, Humphrey, Kincaid, Pawnee, Pawnee Junction, Sicily, and Vollenhine, Ill. Present rate, \$4.10 per net ton to Auburn and Beechley, Ill., and \$4.00 per net ton to the other points mentioned above (6th class); proposed, \$1.23 per net ton, via Wabash railway, Taylorville, Ill., and C. & I. M. railway.

13031. **Crushed stone**, carloads, Waterville, Ohio, to Sylvania, Allen Jct., and Fayette, Ohio. Present rates, 70 cents to Sylvania, Ohio, and 80 cents to Allen Junction, and Fayette, Ohio; proposed, 90 cents per net ton.

13033. **Crushed stone**, carloads, Holland, Ohio, to Detroit, Mich. Present rate, \$1.05 per net ton; proposed, 70 cents per net ton.

13065. **Crushed stone**, carloads, Piqua, Ohio, to Lima and Cridersville, Ohio. Present rate, 70 cents per net ton; proposed, 60 cents per net ton.

13072. **Crushed stone**, carloads, Putnamville, Ind., to Indiana Girls' School, Ind. Present rate, 6th class, 13½ cents; proposed, \$1.00 per net ton.

Southern Freight Association Docket

26170 (shippers). **Sand**, other than blast, engine, foundry, glass molding or silica, carloads, minimum weight 90% of marked capacity of car, except when car is loaded to cubical or visible capacity, actual weight will apply, from Cape May, N. J., to Cranerton, N. C. Present rate, \$6.99; proposed, \$5.60 per net ton, based on Norfolk, Va., combination.

26324 (shippers; rates suggested by carriers). **Granite or stone**, carloads, from Rockton, S. C. (when from Rion, S. C.), to Jacksonville, Fla. It is proposed to establish following reduced rates on granite or stone, rubble or crushed, carloads, minimum weight 90% of marked capacity of car, except when cars are loaded to their visible capacity, actual weight will govern, from Rockton, S. C. (when from Rion, S. C.), to Jacksonville, Fla. Proper, \$1.45; for beyond, \$1.40 per net ton. The rate to Jacksonville proper is made on the same basis as observed in constructing present rate from Paelet, S. C., with rate for beyond, made 5 cents per net ton less.

26365 (shippers). **Sand and gravel**, carloads, minimum weight on, in connection with rates published in Agt. Glenn's Montgomery-Selma Tariff. It is proposed to amend Commodity Descriptions 39, 56 and 58 of Agt. Glenn's tariff mentioned above, which now provides commodity description on sand and gravel, subject to carloads, minimum weight of stencilled capacity of car, except when cars are loaded to their visible capacity, actual weight will govern, etc., to provide that carloads, minimum weight of 90% of marked capacity of car, except when cars are loaded to their visible capacity actual weight will govern. The proposed minimum is in line with minimum weight applicable to and from other southeaster points.

26375 (shipper, rates suggested by carrier). **Gravel and sand**, from Montgomery, Ala., group pits to stations on the Southern Ry., between Everett and Brunswick, Ga. Combination rates now apply, and it is proposed to establish on gravel and sand (all kinds), straight or mixed, carloads, minimum weight 90% of marked capacity of car, except when cars are loaded to their visible capacity actual weight will govern, from Montgomery, Ala., and group pits, as follows: To Everett, Ga., \$3.15; Belle Vista, \$3.17; Hunters Spur, \$3.19; Zuta, \$3.21; Walburg, \$3.23, and Sterling, Ga., \$3.25 per net ton. The proposed rates are based on the proposed Georgia scale for application over Trunk Lines, using the distance from Montgomery, Ala.

26376 (shipper). **Ground limestone**, from Sparta, Tenn., to Boston, Mass., and New England points. It is proposed to establish Cincinnati, Ohio, combination rate of \$8.66 per gross ton on ground limestone, carloads, minimum weight 60,000 lb., from Sparta, Tenn., to Boston, Mass., in lieu of present rates of \$9.06. It is also proposed to establish, via Atlanta, Ga., the Cincinnati, Ohio, combination rate of \$8.66 per gross ton to Mystic, Conn., Stoughton, Brockton, South Braintree, Franklin, Taunton and Avon, Mass., in lieu of present combination rates. To other New England points taking \$9.64 rate in N. C. & St. L. Ry., I. C. C. 2972A, it is proposed to establish the Cincinnati combination rate of \$8.66 per gross ton.

26384. (shipper). **Crushed stone**, Ladds, Ga., to Rosedale, Miss. Combination rates now apply, and it is proposed to establish rate of \$2.70 per net ton on crushed stone, carloads, minimum weight marked capacity of car, same as in effect to Greenville, Miss.

26426 (shippers; rate suggested by carriers). **Mica**, Greenville, Ga., to Asheville and Biltmore,

N. C. In lieu of sixth class rate of 59 cents per 100 lb. it is proposed to establish rate of \$5 per net ton on mica, crude or scrap (mica ore), carloads, minimum weight 50,000 lb., from Greenville, Ga., to Asheville and Biltmore, N. C., made same as rate in effect from La Grange, Forsyth, Culloren, Thomaston and Yatesville, Ga., Dadeville, Erin, Kellyton and Lineville, Ala., and is also the same as rates from the same points of origin to Rutherfordton, N. C.

26444 (shippers; rates suggested by carriers). **Flint stone pebbles**, eastern port cities to Minpro, N. C. In lieu of class rates now in effect, it is proposed to establish commodity rates on flint stone pebbles, loose or in bags, barrels or boxes; and flint stone linings (silex linings), loose or in packages, straight or mixed carload, minimum weight 40,000 lb., from New York, N. Y., to Philadelphia, Penn., Baltimore, Md., Washington, D. C., and Alexandria, Va., to Minpro, N. C., the same as currently applicable to Cass, N. C., and Erwin, Tenn.

26454 (shipper; rate suggested by carrier). **Stone**, crushed, Whitestone, Ga., to Montgomery, Ala. In lieu of present rate of \$2.60 per net ton, it is proposed to establish rate of 1.92 per net ton on stone, crushed, carloads, minimum weight 90% of marked capacity of car, except when cars are loaded to their visible capacity, actual weight shall govern, from Whitestone, Ga., to Montgomery, Ala., made same as rate in effect on crushed stone, carloads, from Whitestone, Ga., to equi-distant points in Georgia.

26455 (shipper; rate suggested by carrier). **Crushed stone**, from Dolcote, Ala., to North Birmingham, Ala. In lieu of present rate of 3½ cents per 100 lb., it is proposed to establish rate of 50 cents per net ton (intrastate only) on stone, broken or crushed, carloads, minimum weight 90% of marked capacity of car, except when cars are loaded to their visible capacity actual weight will govern, from Dolcote to North Birmingham, Ala., which is the same as the present rate on crushed stone and slag from Gate City and Enley to North Birmingham, Ala.

26458 (shipper; rate suggested by carrier). **Crushed stone**, Bolingbroke, Ga., to Panama City, Fla. No through rate in effect, and Dothan, Ala., combination applies. Proposed rate on stone, crushed, carloads, minimum weight 90% of marked capacity of car, except when cars are loaded to full visible capacity, actual weight will govern, \$2.13 per net ton, made on basis of the carriers' proposed Alabama-Georgia scale.

26480. **Crushed stone**, Mt. Vernon and Sparks Quarry, Ky., to Richmond, Ky. In lieu of present rate of 4½ cents per 100 lb., it is proposed to establish rate of 80 cents per net ton on stone, crushed, carloads, minimum weight 90% of marked capacity of car, except when cars are loaded to their visible capacity, actual weight will govern, from Mt. Vernon and Sparks Quarry, Ky., to Richmond, Ky., same as current rate from Yellow Rock, Ky., to Richmond, Ky.

26558. **Cement** from Southern cement producing points to Boone and Pineola, N. C. In lieu of combination rates, it is proposed to establish the following commodity rates: From Birmingham, Boyles, North Birmingham, Leeds, Ragland, Ala., and Nashville, Tenn., to Boone, 29½ cents; to Pineola, 27½ cents; from Chattanooga, Tenn., Portland, Rockmart, Ga., and Richard City, Tenn., to Boone, 27½ cents; to Pineola, 25 cents; from Spocari, Ala., to Boone, 31½ cents; Pineola, 29½ cents per 100 lb. Proposed rates are made in line with rates to other points in the same territory.

26579. **Calcite**, from Cartersville, Ga., and Sparta, Tenn., to Milwaukee, Racine, Wis., and Belleville, Ill. It is proposed to establish rate of \$5.02 per net ton on ground limestone, carloads, from Sparta, Tenn., to Milwaukee, Wis., which is made 52 cents over the present rate to Chicago, Ill., and also to establish the proposed rate of \$5.02 to Milwaukee to apply to Racine, Wis., an intermediate point. It is also proposed to establish the Milwaukee rate of \$5.31 from Cartersville, Ga., to apply to Racine, Wis., the suggested rates to be subject to carload minimum weight marked capacity of car, except when car is loaded to full visible capacity, actual weight will govern. Combination rates now apply to the destinations involved.

Trunk Line Association Docket

13239 (carrier). To establish rates on lime, carloads, minimum weight per Official Classification, from Pennsylvania Railroad shipping points: Carpenterville, N. J., Swedeland, Penn., Pleasant Gap, Penn., Baltimore, Md., Union Bridge, Md., Martinsburg, W. Va., Philadelphia, Penn., and various

other points to Canadian territory; Highlands, Montreal, P. Q., Ottawa, Prescott, Ont., Hull, Que., and various other points, 25 cents per 100 lb.; to Quebec and Shawinigan Falls, Que., 26 cents per 100 lb.

Reason—To establish rates from Pennsylvania Railroad shipping points on the same basis as now in force from other producing points, namely, 83.33% of sixth class. File 1355.

13247 (increase carrier). To cancel commodity rate of 75 cents per net ton on crushed stone, carloads, from Fulton, N. Y., to Oswego, N. Y. Classification basis to apply.

13253 (shipper). Slag, a product of iron or steel blast or open hearth furnaces, carloads, from DuBois, Penn., to stations on the P. R. R., Tyrone, Unionville, Irvonia, Mahaffey, Cherry Tree, Clymer, Penn., and various other stations, rates ranging from \$1.15 to \$2.05 per ton. File 38942.

13257 (carrier). Fluxing stone, carloads, minimum weight 90% of marked capacity of car, except when loaded to cubical or visible capacity, actual weight will apply, from DeKalb Junction, N. Y., to East Buffalo, Carroll St., Louisiana St., Ohio St. and Erie St. and Black Rock, N. Y., \$1.89 per gross ton. Reason—Rate is same as now in force from Gouverneur to Black Rock, N. Y. File 38992.

13258 (shipper). Fluxing stone, carloads, minimum weight 90% of marked capacity of car, from Atlas, Hamburg, Lime Crest and McAfee, N. J., to Phillipsburg, N. J., \$1.01 per 2240 lb. Reason—Proposed rate is same as published to Easton and Bethlehem, Penn. File 14529.

13257. Fluxing stone, carloads, minimum weight 90% of marked capacity of car, except when loaded to cubical or visible capacity, actual weight will apply from DeKalb Junction, N. Y., to East Buffalo, Buffalo Carroll St., Louisiana St., Ohio St. and Erie St. and Black Rock, N. Y., \$1.89 per gross ton. Reason: Rate is same as now in force from Gouverneur to Black Rock, N. Y.

13258. Fluxing stone, carloads, minimum weight 90% of marked capacity of car, from Atlas, Hamburg, Lime Crest and McAfee, N. J., to Phillipsburg, N. J., \$1.01 per 2240 lb. Reason: Proposed rate is same as published to Easton and Bethlehem, Penn. File: 14529.

Southwestern Freight Bureau Docket

8062. Limestone, from Carthage, Mo., to points in Kansas. To establish the following mileage scale on agricultural limestone, carloads (to apply on crushed agricultural limestone which has passed or will pass through a screen with circular holes, one-eighth of an inch or less in diameter).

Minimum weight: Minimum weight, 90% of marked capacity of car, except that when weight of shipment loaded to full visible capacity of car is less than 90% of marked capacity of car, actual weight will apply, but in no case shall the minimum weight be less than 40,000 lb., from Carthage, Mo., to points in Kansas on the St. L.-St. F. Ry. within a radius of 260 miles.

Rates in cents per ton of 2000 lb.:

Distance in miles	Rate
50 miles and under	60
60 miles and over 50	65
70 miles and over 60	70
80 miles and over 70	75
90 miles and over 85	85
100 miles and over 90	90
110 miles and over 100	95
120 miles and over 110	100
140 miles and over 120	110
150 miles and over 140	115
170 miles and over 150	120
180 miles and over 170	125
190 miles and over 180	130
200 miles and over 190	135
220 miles and over 200	140
240 miles and over 220	150
260 miles and over 240	155

It is desired that Kansas points be placed on a parity with Oklahoma points.

8063. Gypsum rock, between points in Oklahoma. To amend the description in Item 290 of S. W. L. Tariff 55H, applicable between points in Oklahoma, by adding the following: "Disintegrated gypsum rock or gypsite."

The above change is desired in order to clarify the item, as it is contended that the present description can be applied on this commodity.

8068. Cement, from Medicine Lodge, Kan., to points in Texas. To establish rate of 15 cents per 100 lb. on Keene's cement, carloads, minimum weight 80,000 lb., from Medicine Lodge, Kan., to Acme and Agatite, Texas. Shippers have called our attention to rate of 11½ cents per 100 lb. applicable from Acme, Texas, to Acme, N. M., a distance of 335 miles, and request a similar adjustment from Medicine Lodge, Kan., to Acme, Texas, a distance of 404 miles.

8084. Sand, from points in Oklahoma to points in Kansas. To establish rate of 6½ cents per 100 lb. on sand, carloads, minimum weight marked capacity of car, except when car is loaded to full visible capacity, in which case actual weight will

govern from Gray Kengle, Price, Sand Springs, Shirk and Tulsa, Okla., to Baxter Springs, Columbus, Mound Valley, Cherokee and Parsons, Kan., and directly intermediate points in Kansas on St. L.-S. F. railway. This places Oklahoma on a parity with Kansas City, the basis for which Oklahoma shippers have been contending. The points other than Mound Valley and Parsons added in order to clear Fourth Section.

8124. Phosphate rock, from points in Florida to Shreveport, La. To establish a rate of 21½ cents per 100 lb. on crude phosphate rock, carloads, minimum weight 80,000 lb. per car, from Tampa and Boca Grande, Fla., to Shreveport, La.

The above rate it is desired in order to equalize rates and charges applying via Gulf ports such as Mobile, Ala.

8145. (Cancels 8119.) Marble, from Whitestone, Ga., to points in Texas. To establish rate of \$6.15 per ton of 2000 lb. on crushed marble and crushed stone, carloads, minimum weight 90% of marked capacity of car, except when car is loaded to full visible capacity when actual weight will govern, from Whitestone, Ga., to Dallas and Ft. Worth, Texas. The proposed rate, it is stated, is based on combination of locals using 7 cents per 100 lb. from Vicksburg, Miss., to Shreveport, La.

Transcontinental Freight Bureau Docket

6771. Silica sand, carloads, W. B. Request for rate of 30 cents per 100 lb., minimum weight 80,000 lb. on silica sand from Ottawa, Ill., to Santa Ana, Calif., under Tariff 1Y (I.C.C. 51, A154, 1688 and 1155 of Frank Van Ummersen, H. Wilson, B. T. Jones and H. G. Toll, Agents, respectively).

Western Trunk Line Docket

5319. Sand, gravel, crushed stone, carloads, from Ashland, Allis, Cedar Creek, Cones Spur, La Platte, Louisville, South Bend, Neb., also other points in Nebraska, to stations in Iowa and Missouri. Present, rates are on combination, using Agent B. T. Jones Tariff 228, I. C. C. U. S. 1; proposed, to publish through rates on one of the following bases:

First—The rates in effect February 15, 1915, increased 35% and reduced 10%.

Second—The Nebraska two-line scale.

For example:

To—	Present	—Proposed— Second First (See above)	
C. G. W. R. R.			
Ft. Dodge, Iowa	\$1.54	\$1.90	\$1.63½
Elma, Iowa	2.09	2.50	2.09
Tama, Iowa	1.85½	2.20	1.89½
C. M. & St. P. Ry.			
Cedar Rapids, Iowa	2.03½	2.40	2.04½

5325. Shells, clam, mussel and oyster, crushed, straight or mixed, carloads, from Muscatine, Iowa, to Aberdeen, S. D. Rate, present, 30½ cents per 100 lb. (Class E); proposed, 24 cents per 100 lb. Minimum weight 36,000 lb. (By shipper).

1665B. Sup. 1. Rock, crushed, carloads, from Leeds, Pixleys, Mo., Morris, Kan., Prince-Johnson Limestone Co.'s Spur, Kan., and other stations named in W. T. L. Trf. 164 A, to points in Iowa, Kansas, Missouri and Nebraska. Rates—Present, as named in W. T. L. Trf. 164A; proposed, to establish same rates from all points of origin named in W. T. L. Trf. 164A as at present in effect from Kansas City, Mo.-Kan., to the same points. Minimum weight, 90% of marked capacity of car, except that when weight of shipment loaded to full visible capacity of car is less than 90% of marked capacity of car, the actual weight will apply, but in no case shall the minimum carload weight be less than 40,000 lb.

5339. Sand, carload. From Klondike, Mo., to Topeka, Kan. Rate: Present, 14½ cents per 100 lb.; proposed, 11½ cents per 100 lb. Minimum weight, 90% of marked capacity of car, except when loaded to full visible capacity actual weight will apply, except minimum be not less than 40,000 lb.

New England Freight Association Docket

10020. Crude talc, ground or lump, minimum weight 50,000 lb., from Johnson, Vt., to Livermore Falls, Maine, 20 cents; Rumford, Maine, 21 cents; Orono, Maine, 22 cents. Reason—Comparable with rates currently effective to Berlin and to Franklin, N. H.

10021. Lime, common, minimum weight 40,000 lb., from Swanton, Vt., to Cumberland Mills, Maine, 16 cents; Gardiner, Maine, 17½ cents, via the St. J. & L. C. R. R.-Me. C. R. R. Reason—Rate to Cumberland Mills same as in effect for B. & M. R. R. delivery and to Gardner rate comparable with that currently effective to Howland, Maine.

10068. Lime and limestone, minimum weight, 40,000 lb., from Cheshire, Farnams, North Adams, Pittsfield, Renfrew, Richmond, State Line and Zylonite, Mass., to South Scanton, Minooka-Taylor, Moosic, Avoca, Pittston, Yatesville, Laflin, Hudson, Miners Mills, Parsons, Plymouth and Wilkes-Barre, Penn.: Lime, 17; limestone, 16. Reason: To place the rates on a comparative basis with rates to other points on the D. & H. Co.

Brick Scale Established for Cement Products

THROUGH the efforts of the traffic committee of the Concrete Products Association and the concrete products sub-committee of the committee on transportation of the Portland Cement Association, the Central Freight Association has established the principle that no higher freight rates should be charged on cement block, brick and building tile or staves than on similar clay products.

With this principle established, cement products manufacturers operating in Central Freight Association territory, desiring an adjustment of rates, should submit to the individual carrier serving each of their plants, specific requests for such rates as they desire put into effect. The shippers must represent to the railroads their need for a rate as low as that being obtained by competing clay products factories.

Specific rates from each point must be worked out separately and according to established procedure. This means that members of the Concrete Products Association within Central Freight Association territory must make application with the lines serving their plants, asking for rates on the same basis as clay brick, if brick rates are published from that territory; or comparable with clay brick rates from nearby brick producing points. The originating roads will then proceed in the usual manner, and with the principle established as outlined above, there should be no trouble in getting specific rates authorized.

The traffic committee of the Concrete Products Association, of which E. W. Dienhart, Cement City, Mich., is chairman, in conjunction with the sub-committee of the Portland Cement Association, will be glad to assist products manufacturers in preparing applications to originating lines for proper adjustment of rates on their products.

The rates established should open up many new markets heretofore closed to cement products manufacturers in Central Freight Association territory. Not only will the cement products manufacturers be benefited by this ruling but the carriers will come in for a much larger volume of business through a greater movement of freight over their lines.

For the information of shippers, Central Freight Association territory embraces, roughly, the states of Ohio, Indiana, Michigan (excepting upper peninsula), points in Illinois south of a line drawn from Chicago to Peoria, and cities in Pennsylvania and New York included in the territory west of a line extending from Buffalo to Pittsburgh, including the latter points.

The way is now clear to secure similar advantages in parts of the country outside of Central Freight Association territory, which the above committees plan to do if there is sufficient interest shown on the part of cement products manufacturers.

Kansas City Cement Rates

ANOTHER proposal for dealing with the cement rate adjustment into Kansas City, Mo.-Kan., has been made by Examiner John T. Money in a report, on further hearing on No. 15117, Iola Cement Mills Traffic Association et al. vs. Atchison, Topeka and Santa Fe et al. and No. 15138, Atlas Portland Cement Co. of Kansas vs. Same. He said the commission should find rates on cement from the Kansas gas belt to points in the two-state city switching district not unreasonable, but unduly prejudicial of manufacturers of cement in the gas belt and unduly preferential of manufacturers of cement at Cement City (Sugar Creek, Mo.) and Bonner Springs and Sunflower, Kan. He proposed rates on the basis of $\frac{1}{2}$ cent less than the rates produced by the use of scale II, prescribed in Western Cement Rates, 48 I. C. C. 201, and the supplemental reports therein, 52 I. C. C. 225 and 69 I. C. C. 644, instead of the basis prescribed in Cement from Bonner Springs, 83 I. C. C. 176, which was prescribed in October, 1923.

As the cases involved intrastate rates, the Kansas and Missouri authorities were notified and a joint hearing was held with the Kansas commission. The Missouri Portland Cement Co., with a mill at Cement City, and the Kansas Portland Cement Co., with a mill at Bonner Springs and Sunflower, Kan., the examiner said, intervened in opposition to the complainants. He devoted particular attention to the position of the Cement City intervener. The positions of the three parties in the controversy, it is believed, are indicated by the summing up and recommendations of the examiner, which are as follows:

In support of their contention that rates from the gas belt to Kansas City should be the same percentage of scale II as are the rates from Cement City, complainants instance relatively lower rates on various low-grade commodities such as brick, sewer pipe and other clay products, from the gas belt district and coal from the Pittsburg, Kan., coal field to Kansas City and intrastate rates on cement of 8 cents from Portland and Concrete to Denver, Colo., and 7 cents from Cement City to St. Joseph, Mo. The 7-cent rate on cement from Cement City to St. Joseph was found to be unduly preferential of Cement City and unduly prejudicial of intrastate shippers from the gas belt in Cement from Kansas City to St. Joseph, 96 I. C. C. 718, decided April 16, 1925. In that case, where the issues were similar to those here presented, the commission required that the prejudice and preference be removed by the establishment from Cement City to St. Joseph and intermediate points over the intrastate routes rates based on scale II, which scale was applicable on interstate traffic from and to the same points. Scale II rate to St. Joseph from Cement City is 9 cents based on the distance from Kansas City, which is the authorized basis for calculating distances from both Cement City and Bonner Springs. Reference is also made to intrastate rates on cement lower than the interstate scales from Illinois mills to Chicago, Ill., from Hannibal, Mo., to Kansas City and St. Louis, Mo., between St. Louis and Kansas City, and from Superior, Neb., to

Omaha, Neb. These intrastate rates were neither prescribed nor approved by this commission, but are maintained under state authority and their lawfulness has not been questioned by interstate shippers.

There is merit in defendant's contention that if the rates from the Kansas gas belt are reduced to the same percentage of scale II that the rate from Cement City is of scale II, it will seriously reduce their revenue, quite likely result in demands from other cement manufacturers at other points for rates less than the scale to principal markets, and ultimately tend to break down the entire cement rate structure of western trunk line and adjacent territories, established and maintained only after years of laborious efforts and painstaking. But if the 4.5 cents rate is continued from Cement City and Bonner Springs, it would seem that the gas belt mills are entitled to rates the same percentage of scale II for the average distance as are the rates from the alleged preferred points for their average distance. Such a basis would result in a rate of 7 cents from the gas belt.

On behalf of the intervener at Cement City, it is urged that the rates from such mill to Kansas City should be less than the mileage scale, for the reason the services of the Santa Fe in handling cement from Cement City is wholly within the switching district of the carrier's terminal, and that the rates might be lower than the scale from other cement producing points where the movement is entirely in road-haul service. The propriety of departing from the uniform scale applicable throughout a wide territory cannot depend upon whether particular movements are switching or a road-haul service. Cement from Cement City does not compete with other commodities upon which the switching rates at Kansas City are upon a per car or per 100-lb. basis substantially lower than on cement. But certain combinations of switching rates at Kansas City on certain classes of traffic are somewhat higher than the 4.5 cent rate on cement from Cement City. Cement from Cement City meets at Kansas City the competition of cement from Bonner Springs, Kansas gas belt, Hannibal, Mo., and other cement-producing points. In determining the level of the rates on cement prescribed in Western Cement Rates and in various cases concerning rates in adjacent territories, and for intrastate application generally throughout the same territory, the commission has taken into consideration all of the factors which usually enter into the reasonableness of rates, but has considered distance and terminal costs of primary importance. It has not been controlled in such cases by the general level of rates on other commodities, whether switching or line-haul, its principal consideration being the general level of the rates on cement. There is nothing in this record which in any respect indicates that the terminal costs on traffic from Cement City and Bonner Springs is less than on traffic from the various producing points in the Kansas gas belt. In fact, it appears that much of the traffic from Cement City entails intermediate switching between the Santa Fe and delivering lines, and that no such intermediate switching is used, at least, to such an extent, in connection with traffic from the Kansas gas belts, as the mills at such points are served by carriers maintaining extensive terminals at Kansas City which obviates the necessity of any additional terminal line to effect delivery. As heretofore stated, prior to March 5, 1923, the so-called switching charges from Cement City (Sugar Creek) applied only to local deliveries including railway connections at Kansas City, but since that date the 4.5 cent rate has applied to all points on other lines and the

Santa Fe absorbs all switching charges of other lines. It is stated that in many instances such absorptions are substantial and in some instances such absorptions reduce the net earnings of the Santa Fe on a 50,000 lb. shipment—the applicable minimum—to from \$1.20 to \$5.05 per car. Similar absorptions are also made on cement from other points, but the net revenue to the originating lines is materially greater.

The position of the intervener at Cement City is unique. It is not unusual for a mill, a substantial distance from an important consuming center, to seek to depart from a uniform mileage scale to enable it more nearly to meet the competition of a nearby mill, which in most instances is contiguous to the consuming center and ships under the same uniform scale. Here, however, we have the situation of a nearby mill seeking to retain not only the lower rate under this scale which its location near the consuming territory entitles it, but also to retain the further benefit of a basis substantially lower than it would be entitled to under such scale. It is easier to comprehend the farther distant mill seeking an alleviation of the disadvantage under which the scale placed it than it is to grasp the logic of the nearby mill seeking the extension of an already very substantial advantage which its geographical location gives it under the scale. This view is none the less forceful because of the fact that the nearby mill is located within the switching district of a large city where is the principal consumer of cement from both the nearby and more distant mills. The competition created by the nearby mill would not be one bit lessened if such mill was so situated as to make its haul to such consuming center partake of the nature of what has been referred to as a switching movement rather than a line-haul movement. The fact that the switching and per car rates and charges on other commodities are lower than the rates produced by the uniform mileage scale on cement between the same points, or that the mileage scale is not applied to short hauls within terminals at other points in the western territory, cannot control the situation here in the absence of a showing that the conditions are substantially similar and that no undue prejudice results therefrom. Kansas City is one of the complainant's largest markets for cement and they actively compete at that point with cement from Cement City, Bonner Springs and Sunflower. The rates from each of these mills should be on the same basis and nothing less than the same basis will remove the cause of these complaints which since August, 1918, has been a disturbing element in the western cement rate adjustment. The key point rate from the Kansas gas belt to Kansas City is $\frac{1}{2}$ cent less than scale II, and the rates from Cement City, Bonner Springs and Sunflower should be $\frac{1}{2}$ cent less than the scale based on the average distance from such points. The parity in rates from Cement City to Bonner Springs and Sunflower should be continued.

The commission should find that the circumstances and conditions surrounding the transportation of cement, in carloads, from points in the Kansas gas belt from Bonner Springs and Sunflower and from Cement City (Sugar Creek) to Kansas City, Mo.-Kan. switching district are substantially similar. The commission should further find that the rates on cement, in carloads, from the Kansas gas belt, including Independence, to points in the Kansas City, Mo.-Kan., switching district as defined in the tariffs of the delivering lines are not unreasonable, but that, with the exception of points on the Kansas City railways between Dodson and Westport, Mo., they are unduly prejudicial to the Kansas gas belt points and shippers

therefrom and unduly preferential to Bonner Springs and Sunflower, Kan., and Cement City (Sugar Creek), Mo., and shippers therefrom. The commission should further find that the establishment of rates on cement, in carloads, from Bonner Springs, Sunflower and Cement City (Sugar Creek) to all points within the switching district of Kansas City, except from Sunflower to points on the Kansas City railways, should be on basis $\frac{1}{2}$ cent less than scale II rate for the average distance from Cement City (Sugar Creek), Bonner Springs and Sunflower to Kansas City, Mo., and the contemporaneous maintenance of rates of 11 cents from the Kansas gas belt, will remove the undue prejudice found to exist.

The 7-cent rate from Bonner Springs to points on the Kansas City railways between Dodson and Westport results in undue preference of Bonner Springs and undue prejudice of the Kansas gas belt to the extent that the rate from Bonner Springs is less than the rate suggested herein from Sugar Creek.

The order dated October 9, 1923, in Cement from Bonner Springs, 83 I. C. C. 176, should be vacated and appropriate orders entered to effectuate the findings herein proposed.

The Union Pacific and Kaw Valley do not participate in or have any control over the rates attacked from the Kansas gas belt and cannot be held responsible for the prejudice. Such carriers should revise their rates from Bonner Springs and Sunflower to Kansas City to the basis established from Cement City (Sugar Creek).

Crushed Stone Rates Held Reasonable

EXAMINER HORACE W. JOHNSON has recommended the dismissal of No. 17255, West Virginia State Road Commission vs. Pennsylvania et al., on a finding that the rate charged on crushed stone, from Marble Cliff, Ohio, to Cairo, W. Va., on shipments between May and September, 1924, was not unreasonable. A rate of \$2.25 per net ton was charged. The complainant contended it was unreasonable to the extent it exceeded \$1.44. Comparisons were made with lower rates to other points in West Virginia. The carriers said the lower rates were made to meet Ohio river competition.—*Traffic World*.

Sand From Sandusky

A FINDING of unreasonableness for the future, as to the freight rate on sand from Sandusky, Ohio, to Pittsburgh, Penn., has been recommended by Interstate Commerce Commissioner Examiner Arthur Kettler, in No. 17038, Booth and Flinn vs. Pennsylvania. The examiner said the commission should find the rate unreasonable on sand, other than blast, engine, foundry, glass, molding or silica, over the line of the Pennsylvania, to the extent it exceeds \$1.60 per net ton. He said the commission should find that the record did not show that the rates were unreasonable in the past and that therefore reparation should be denied.—*Traffic World*.

Ask That Kelly Tariff Apply to Mississippi Rates

RATES on sand and gravel from Gravel Siding, Miss., to points in Arkansas were involved in the hearing on Docket 16799, the Allen Gravel Co. against the Rock Island, et al., before Examiner Carter at Chicago recently.

A. C. Butterworth, president of the Allen Gravel Co., Little Rock, Ark., told of the use of gravel produced by his company in road making in the South and testified that the company had been unable to meet the prices of competitors, due to the freight rates met by the complainant.

C. B. Ackerman, rate witness for the complainant, testified that the rates desired by the gravel company ranged from \$1.29 to \$1.49 a ton, while the rates charged were from \$1.59 to \$1.79 a ton. He said the complainant contended that the rules of the Kelly combination tariff should apply and, if used in computing the rates, it would give the lower rates asked by the complainant.

G. F. Potter, for the Southern, testified as to the rules laid down in the Kelly tariff, or U. S. No. 1, pointing out that there were lines that were not participating lines in the provisions of the Kelly tariff. He said that Gravel Siding was to the east of Memphis, Tenn., and that the complainant was seeking the Memphis combination to points west of Memphis, and, he said, the lines west were not participating lines in the tariff the complainants wished to be used in making the lower rates.

Rates on Sand and Gravel to Chicago District Claimed Unfair

HEARING in Docket 17817, the Chicago Sand and Gravel Co. et al., against the Santa Fe et al., was begun recently before Examiner Fuller in Room 1720, the Transportation Building, Chicago, but, due to an adjournment from the rooms of the Illinois commission, and in discussion of the position of parties to the case, the hearing barely got under way. Rates involved are those on sand and gravel from producing points in the inner zone of the Chicago district to the Chicago district as a market, which have been complained of as unreasonable and prejudicial in favor of rates from the outer zones to the same market.

Burton H. Atwood, on behalf of the complainant, was the first witness. He gave a history of the gravel rates, and the zone adjustment, tying these up with the growth and expansion of the city. He pointed out that the industry was old and, naturally, the first producing centers were nearest the city; then, with the expansion, the producing points were pushed out from the Chicago market and the problem of a rate ad-

justment, taking into account the natural market of all the points of production, began to appear. The outgrowth of the situation was the zone system of making rates on sand and gravel in Chicago, up to the first 50 miles being the first zone, a radius up to 100 miles being the second, and up to 150 the third.

A. Deutsche, of the North Shore Material Co., G. W. Renwick, of the Chicago Gravel Co., R. Duffy, of Richardson Sand and Gravel Company, R. E. Thomas of the American Sand and Gravel Co. were commercial witnesses as to the keen competition for business in the Chicago district market and the importance the slightest difference in freight rates made in getting business.

Further testimony of a commercial nature was given by J. L. Hodgson, of the American Sand and Gravel Co.; R. A. McFarlane, of the Wisconsin Lime and Cement Co.; E. T. Bostler, Rockwell Lime Co.; and E. Gillette, of the A. Y. Read Sand Co. They testified as to competition between plants in the Chicago district for business in the Chicago market, taking the position that there was business in northwestern Indiana, northern Illinois, southern Wisconsin and Chicago that might be gotten by their firms if the freight rates did not prevent them making prices low enough to meet competition.—*Traffic World*.

Crushed Stone Freight Rates

AN order of dismissal has been made in No. 16638, Raleigh Freight Traffic Bureau vs. Atlantic Coast Line et al., mimeographed, as to rates on crushed stone, from Columbia, S. C. to Wilford and Edwards, N. C. The Interstate Commerce Commission, by division No. 3, found the past and present rates to Dean Siding, N. C., not unreasonable. It found that the reasonable rates from Columbia to Dean Siding, in the period of movement between January and September, 1924, would have been \$1.89 per ton, and that the defendants should adjust their charges on the shipments to that point to the basis of that rate.—*Traffic World*.

Phosphate Rock Rates

ATTORNEY-EXAMINER ARTHUR R. MACKLEY, in a report on No. 16867, Gulfport Fertilizer Co. vs. Atlantic Coast Line et al., said the commission should find the carload rates on phosphate rock, from Brewster, Bradleys and Achan, Fla., to Gulfport, Miss., between March 22 and December 18, 1920, unreasonable to the extent that the rates of \$4.50 per ton prior to August 26, 1920, and \$5.625 thereafter exceeded \$4.10 and \$5.13 respectively and award reparation to that basis.—*Traffic World*.

Mid-West Division of National Crushed Stone Association Meets at St. Louis

Many City and State Officials
Are Guests of Quarry Men
and Discuss Mutual Problems
and Luncheon Together



Party at Columbia Quarry Co.'s new plant at Krause, Ill.; from left to right, Fred C. Murphy, E. J. Krause, O. M. Graves, C. H. Krause, C. E. Klaus, C. E. Glasson, J. R. Boyd, Horace Krause, A. T. Goldbeck, Martin Hammerschmidt



Quarry of the Columbia Quarry Co., Krause, Ill.

A MOST enjoyable and instructive meeting of the Mid-West Division of the National Crushed Stone Association was held at the Jefferson hotel, St. Louis, Mo., on April 15. President Graves, of the association, was there and delivered one of his admirable addresses outlining the work and prospects of the National Crushed Stone Association.

At a noon luncheon the crushed stone producers were hosts to the mayor of St. Louis, the superintendent of public works, the highway engineer of St. Louis county, Illinois, the commissioner of public works of East St. Louis, Ill., and engineering representatives of the Illinois State Highway Department. The mayor made a friendly address and President Graves made appropriate remarks on behalf of the crushed stone industry. W. R. Sanborn, of the Lehigh Stone Co., Kankakee, Ill., was toastmaster.

Following the luncheon was an open meeting of the quarry men, at which various activities of the National Crushed Stone Association were discussed. A. T. Goldbeck, chief of the bureau of engineering of the association, read a digest of work accomplished and plans made. This was followed by a free-for-all discussion. J. R. Boyd spoke of his work and his plans to develop the *Crushed Stone Journal*.

President Graves made an eloquent plea for support of the National Crushed Stone Association's program, which he promised would grow and expand as fast as means was found to finance new efforts. Meanwhile work has been initiated which will eventually prove invaluable to the quarry industry. President Graves estimated that of the 100,000,000 tons of crushed stone produced annually, between 60,000,000 and 70,000,000 tons was already represented in



Rotary car dumpers at new Krause crushing plant of the Columbia Quarry Co.

financial support should be expected from the association, and that more and greater those who are now members.

Among those present were many crushed stone quarry men in the city of St. Louis—members of the St. Louis Quarrymen's Association—who had not hitherto attended a National Crushed Stone Association meeting.

On the day following the meeting a party consisting of President Graves, A. T. Goldbeck, J. R. Boyd, F. C. Murphy, Martin Hammerschmidt and the editor were the guests of E. J. Krause, his brother, Dr. C. H. Krause, and his son, Horace Krause, at the Columbia Quarry Co.'s new plant at Krause, Ill.

This plant has many new and novel features, including rotary car dumpers of special design and a unique screening system, which had not been completed at the time of the visit.

Following is the registration of the quarry men present at the meeting:

Paul M. Nauman, Dubuque Stone Products Co., Dubuque, Iowa.
J. E. Weber, Casper Stolle Quarry and Construction Co., East St. Louis, Ill.
F. W. Stolle, Casper Stolle Quarry and Construction Co.
F. L. Fehlig, Fehlig Construction Co., East St. Louis, Ill.
J. J. Helfer, Weldon Springs, Mo.
H. C. Krause, Columbia Quarry Co., St. Louis, Mo.
W. Kieffer, Columbia Quarry Co.
H. G. Wilson, Columbia Quarry Co.
T. T. Krainkee, Union Quarry Co., St. Louis, Mo.
J. F. Bambrick, Bambrick Bros. Construction Co., St. Louis, Mo.
E. B. Taylor, Mid-West Crushed Stone Co., Greencastle, Ind.
G. H. Rippetoe, Anna Stone Co., Anna, Ill.
J. R. Beerhalter, Duluth Crushed Stone Co., Duluth, Minn.
J. W. McCullough, Rock Hill Quarry Co., St. Louis, Ill.
H. E. Bullman, Rock Hill Quarry Co.
Frank Stolle, Grant Road Quarry Co., St. Louis, Mo.
C. A. Stolle, Grant Road Quarry Co.
H. B. Hudson, Blackwater Stone Co., Consolidated Crushed Stone Corp., Kansas City, Mo.
Martin Hammerschmidt, Elmhurst-Chicago Stone Co., Elmhurst, Ill.
F. C. Murphy, Brownell Improvement Co., Chicago, Ill.
M. Edgeworth, Lehigh Stone Co., Kankakee, Ill.
W. R. Sanborn, Lehigh Stone Co.
James Travilla, Pilot Knob Ore Co., St. Louis, Mo.
W. A. Grant, Southern Illinois Limestone Co., St. Louis, Mo.
John Wunder, Gopher Stone Co., Trap Rock Co., Minneapolis, Minn.
R. Newton McDowell, Consolidated Crushed Stone Corp., Blackwater Stone Co., Kansas City, Mo.
A. E. Rhodes, Franklin County Limestone Co., Nashville, Tenn.
Col. O. P. Chamberlain, Dolese and Shepard Co., Chicago, Ill.
T. Frank Quilty, Superior Stone Co., Chicago, Ill.
Daniel Foley, Federal Stone Co., Chicago, Ill.
Norman L. Hely, Edward Hely Stone Co., Cape Girardeau, Mo.
J. W. Tanner, Mutual Quarry Co., St. Louis, Mo.
G. Eyermann, Jr., Eyermann Construction Co., St. Louis, Mo.
A. H. Schmalz, Eyermann Construction Co.
Thomas Boyd, Golconda Portland Cement Co., St. Louis, Mo.
W. S. Watson, Golconda Portland Cement Co.
R. G. Forman, Columbia Quarry Co., St. Louis, Mo.
A. R. Kunge, Tower Grove Quarry, St. Louis, Mo.
S. S. Hoag, Tower Grove Quarry.
M. E. McLean, East St. Louis Stone Co., East St. Louis, Ill.
Ralph E. McLean, East St. Louis Stone Co.

A. P. Sandles for Governor of Ohio

WE learn A. P. Sandles is out for governor in the coming Ohio democratic primary campaign. We feel sure every one acquainted with Mr. Sandles and his work for the quarry interests wishes him success—republican or democrat. If he has as many friends in Ohio as he has in the quarry industry, there will be no doubt of his nomination and election. In order to prosecute his campaign he has severed his connection with the crushed stone industry.



A. P. Sandles

The following is the official letter of resignation to the Ohio Crushed Stone Association:

"After nearly 10 years of service as Secretary of the Ohio Crushed Stone Association, my connections therewith ended April 15, 1926.

"My reason for resigning is my desire to seek nomination for Governor of Ohio at the coming primary, August 10.

"Claude L. Clark, assistant secretary, and advertising manager of this magazine, is also resigning after eleven years of service. Mr. Clark will assist me in my primary campaign.

"Our connection with the members of this association has been pleasant. Our association work has been honorable and open to public inspection at all times. We have received many courtesies from public officials in this and other states. The association work will continue, and be in charge of Carl L. Van Voorhis, who is thoroughly competent and qualified for the task.

"Thanks are due from us to our association members, our readers and many friends. Respectfully, "A. P. SANDLES."

Louisiana's First Lime Plant Completed

THE construction work on the first unit of the lime plant being built for the Southern Mineral Co., Winnfield, La., has been completed. This will be the first lime plant in Louisiana. The kiln is only of 10-ton capacity and is intended to serve as a "pilot" for a larger plant of about 250 tons daily capacity to be erected at a later date. The new unit was designed by John C. Schaffer, president of the Schaffer Engineering Co., Pittsburgh, Penn., which company also supervised the construction.

G. F. Daggett New Secretary of Wisconsin Mineral Aggregate Association

GORDON F. DAGGETT has been appointed executive secretary of the Wisconsin Mineral Aggregate Association, Milwaukee, Wis., to succeed Norman K. Wilson, resigned.

Mr. Daggett has had several years of experience in general engineering and highway work and is well known throughout the state. For 13 years he has been with the Wisconsin Highway Commission in various capacities, serving as materials engineer for the past year and a half. He is a graduate civil engineer from the University of Wisconsin, a member of the American Society of Civil Engineers, a member of the Engineering Society of Wisconsin and with his



Gordon F. Daggett

wide acquaintance among engineers, contractors and material men is ably qualified for this position.

The Rock Products Market

Wholesale Prices of Crushed Stone

Prices given are per ton, F.O.B., at producing point or nearest shipping point

		Crushed Limestone					
City or shipping point		Screenings, ¾ inch down	¾ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
EASTERN:							
Buffalo, N. Y.		1.30	1.30	1.30	1.30	1.30	1.30
Chaumont, N. Y.		.50	1.75	1.75	1.50	1.50	1.50
Chazy, N. Y.		.75	1.65	1.65	1.40	1.40	1.40
Cobleskill, N. Y.		1.50	1.35	1.25	1.25	1.25	1.25
Dundas, Ont.		.53	1.05	1.05	.90	.90	.90
Eastern Pennsylvania		1.35	1.35	1.35	1.35	1.35	1.35
Frederick, Md.		.50	.75	1.30	1.20	1.10	1.10
Munns, N. Y.		1.00	1.25	1.40	1.30	1.25	1.25
Northern New Jersey		1.60	1.50@1.80	1.30@2.00	1.40@1.60	1.40@1.60	1.40@1.60
Prospect, N. Y.		1.00	1.50	1.40	1.30	1.30	1.30
Walford, Penn.		.70	1.35	1.35	1.35	1.35	1.50
Watertown, N. Y.		.50	1.25	1.75	1.50	1.50	1.50
Western New York		.85	1.25	1.25	1.25	1.25	1.25
CENTRAL:							
Afton, Mich.				.50			1.50
Alton, Ill.		1.85		1.85			
Bloomville, Middlepoint, Dun-							
kirk, Bellevue, Waterville, No.							
Baltimore, Holland, Kenton,							
New Paris, Ohio; Monroe,							
Mich.; Huntington, Bluffton,							
Ind.		1.00	1.10	1.10	1.00	1.00	1.00
Buffalo and Linwood, Iowa		1.10		1.10	.90	.95	.95
Chasco, Ill.		1.25					1.15
Columbia, Krause, Valmeyer, Ill.		1.00@1.50	1.20@1.25	1.20@1.25	1.20	1.20	1.50
SOUTHERN:							
Cypress, Ill.		1.15	1.15	1.15	1.15	1.05	1.00
Greencastle, Ind.		1.30	1.25	1.15	1.05	.95	.95
Lannon, Wis.		.80	1.00	1.00	.90	.90	.90
Milltown, Ind.			.90@1.00	.75@.85	.90@1.00	.85@.90	.85
Northern New Jersey		1.30		1.80	1.60	1.40	
River Rouge, Mich.		1.10	1.10	1.10	1.10	1.10	1.10
St. Vincent de Paul, Que.		.75	1.25	1.00	.90	.85	1.00
Sheboygan, Wis.		1.10	1.10	1.10	1.10	1.10	1.10
Toledo, Ohio		1.60	1.70	1.70	1.60	1.60	1.60
Stone City, Iowa		.75		1.15†	1.05	1.00	
Waukesha, Wis.		.90	.90	.90	.90	.90	.90
WESTERN:							
Alderson, W. Va.		.60	1.45	1.45	1.35	1.25	1.20
Allgood, Ala.			Crusher run, fines out.	for flux, 1.00 per net ton			
Cartersville, Ga.			1.50	1.50	1.25	1.15	1.10
Chico, Texas		1.00	1.35	1.30	1.25	1.15	1.10
El Paso, Tex.		1.00	1.00	1.00	1.00		
Ft. Springs, W. Va.		.50	1.60	1.50	1.35	1.25	
Graystone, Ala.			Crusher run fluxing stone, 1.00 per net ton				
Henderson, N. C.			1.50	1.50	1.25	1.25	1.25
McCook, Ill.		1.00	1.25	1.25	1.25	1.25	1.25
New Braunfels, Tex.		.30@1.00	1.00@1.30	1.00@1.30	.70@1.00	.70@.90	
Olive Hill, Ky.		.50@1.00†	1.00	1.00	1.00	1.00	1.00
Rocky Point, Va.		.50@1.00	1.40@1.60	1.30@1.40	1.15@1.35	1.10@1.20	1.00@1.05
Crushed Trap Rock							
City or shipping point		Screenings, ¾ inch down	¾ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Branford, Conn.		.60	1.70	1.45	1.20	1.05	
Duluth, Minn.		.90	2.25	1.90	1.50	1.35	1.35
Dwight, Calif.		1.00	1.00	1.00	.90	.90	
Eastern Maryland		1.00	1.60	1.60	1.50	1.35	1.35
Eastern Massachusetts		.85	1.75	1.75	1.25	1.25	1.25
Eastern New York		.75	1.25	1.25	1.25	1.25	1.25
Eastern Pennsylvania		1.10	1.70	1.60	1.50	1.35	1.35
Knappa, Texas		2.50	2.00	1.55	1.35	1.25	
New Haven, New Britain,							
Meriden & Wallingford, Conn.		.80	1.70	1.45	1.20	1.05	1.05
Northern New Jersey		1.50	2.00	1.80	1.40	1.40	
Oakland and El Cerrito, Cal.		1.00	1.00	1.00	.90	.90	
San Diego, Calif.			2.75	2.55	2.35	2.35	
Sheboygan, Wis.		1.00	1.10	1.10	1.10	1.10	
Springfield, N. J.		1.60	2.00	2.00	1.60	1.60	
Westfield, Mass.		.60	1.50	1.35	1.20	1.10	

Crushed Trap Rock

City or shipping point		Screenings, ¾ inch down	¾ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Branford, Conn.		.60	1.70	1.45	1.20	1.05	
Duluth, Minn.		.90	2.25	1.90	1.50	1.35	1.35
Dwight, Calif.		1.00	1.00	1.00	.90	.90	
Eastern Maryland		1.00	1.60	1.60	1.50	1.35	1.35
Eastern Massachusetts		.85	1.75	1.75	1.25	1.25	1.25
Eastern New York		.75	1.25	1.25	1.25	1.25	1.25
Eastern Pennsylvania		1.10	1.70	1.60	1.50	1.35	1.35
Knappa, Texas		2.50	2.00	1.55	1.35	1.25	
New Haven, New Britain,							
Meriden & Wallingford, Conn.		.80	1.70	1.45	1.20	1.05	1.05
Northern New Jersey		1.50	2.00	1.80	1.40	1.40	
Oakland and El Cerrito, Cal.		1.00	1.00	1.00	.90	.90	
San Diego, Calif.			2.75	2.55	2.35	2.35	
Sheboygan, Wis.		1.00	1.10	1.10	1.10	1.10	
Springfield, N. J.		1.60	2.00	2.00	1.60	1.60	
Westfield, Mass.		.60	1.50	1.35	1.20	1.10	

Miscellaneous Crushed Stone

City or shipping point		Screenings, ¾ inch down	¾ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Berlin, Utley, Montello and Red							
Granite, Wis.—Granite		1.30	1.70	1.50	1.40	1.40	
Coldwater, N. Y.—Dolomite				1.50 all sizes			
Columbia, S. C.—Granite				1.75		1.50	
Eastern Penn.—Quartzite		1.20	1.35	1.25	1.20	1.20	1.20
Havelock, Ontario			2.60	2.10			
Lithonia, Ga.—Granite		.75	1.75	1.60	1.40	1.35	1.35
Lohrville, Wis.—Granite		1.65	1.70	1.65	1.45	1.50	
Middlebrook, Mo.—Granite		3.00@3.50		2.00@2.25	2.00@2.25		1.25@2.00
Northern New Jersey (Basalt)		1.50	2.00	1.80	1.40	1.40	
Richmond, Calif.—Quartzite		.75		1.00	1.00	1.00	
Somers, Pa. (sand-rock)		1.85@2.00a		1.35@1.50		1.90@1.50	
Toccoa, Ga.—Granite				1.60	1.45	1.40	

*Cubic yd. †1 in. and less. ‡Two grades. §Rip rap per ton. (a) Sand. (b) to ¾ in. (c) 1 in., 1.40. (d) 2 in., 1.30. (e) Dust. (f) ¾ in. (h) less 10c discount. (i) 1 in., 1.40.

Agricultural Limestone (Pulverized)

Alderson, W. Va.—90% thru 50 mesh.	1.50
Alton, Ill.—Analysis 99% CaCO ₃ , 0.3% MgCO ₃ ; 90% thru 100 mesh.	6.00
Asheville, N. C.—Analysis, 57% CaCO ₃ , 39% MgCO ₃ ; 50% thru 100 mesh; 200-lb. burlap bag, 4.00; bulk	2.75
Atlas, Ky.—90% thru 100 mesh.	2.00
50% thru 100 mesh.	1.00
Belfast and Rockland, Me. (rail), Lincolnville, Me. (water), analysis CaCO ₃ 90.04%; MgCO ₃ 1.5%, 100% thru 14 mesh, bags.	4.50
Bulk	3.50
Branchton and Osborne, Penn.—100% thru 20 mesh; 60% thru 100 mesh; 45% thru 200 mesh. (Less 50 cents commission to dealers).	5.00
Cape Girardeau, Mo.—Analysis, 93% CaCO ₃ , 3.5% MgCO ₃ ; pulverized; 50% thru 50 mesh.	1.50
Cartersville, Ga.—Pulverized, 2.25; 90% thru 50 mesh.	1.50
Chaumont, N. Y.—Pulverized limestone, bags, 4.00; bulk.	2.50
Chico, Texas.—50% thru 50 mesh, bulk.	1.75
Colton, Calif.—Analysis 90% CaCO ₃ , bulk.	4.00
Cypress, Ill.—90% thru 100 mesh.	1.35
Danbury, Conn., Rockdale and West Stockbridge, Mass.—Analysis, 90% CaCO ₃ , 5% MgCO ₃ ; 50% thru 100 mesh; paper bags, 4.25; cloth, 4.75; bulk	3.25
Henderson, N. C. (paving dust)—80% thru 200 mesh, bags.	4.25@ 4.75
Bulk	3.00@ 3.50
Analysis CaCO ₃ , 56%; MgCO ₃ , 42%; 65% thru 200 mesh, bags.	3.95
Bulk	2.70
Hillsville, Penn.—Analysis, 94% CaCO ₃ , 1.40% MgCO ₃ ; 75% thru 100 mesh; sacked.	5.00
Jamesville, N. Y.—Analysis, 89.25% CaCO ₃ , 5.25% MgCO ₃ ; pulverized, bags, 4.00; bulk.	2.50
Knoxville, Tenn.—Analysis, 52% CaCO ₃ , 37% MgCO ₃ ; 80% thru 100 mesh; bags, 3.95; bulk.	2.70
Marblehead, Ohio—Analysis, 83.54% CaCO ₃ , 14.92% MgCO ₃ ; 60% thru 100 mesh; 70% thru 50 mesh; 100% thru 10 mesh; 80 lb. paper sacks, 5.00; bulk	3.50
Marion, Va.—Analysis, 90% CaCO ₃ , pulverized, per ton.	2.00
Mayville, Wis.—Analysis, 54% CaCO ₃ , 44% MgCO ₃ ; 90% thru 100 mesh.	3.90@ 4.50
Milltown, Ind.—Analysis, 94.50% CaCO ₃ , 33% thru 50 mesh, 40% thru 50 mesh; bulk.	1.35@ 1.60
Olive Hill, Ky.—50% thru 50 mesh, 2.00; 90% thru 4 mesh.	1.00
Piqua, Ohio—Total neutralizing power 95.3%; 99% thru 10, 60% thru 50; 50% thru 100.	2.50@ 2.75
100% thru 10, 90% thru 50, 80% thru 100; bags, 5.10; bulk.	3.60
99% thru 100, 85% thru 200; bags, 7.00; bulk	5.50
Rocky Point, Va.—Analysis 99.5% CaCO ₃ , 0.25% MgCO ₃ ; 50% thru 200 mesh; bags, 3.25@3.50; bulk.	2.00
Toledo, Ohio, 30% through 50 mesh.	2.25
Waukesha, Wis.—90% thru 100 mesh, 4.50; 50% thru 100 mesh.	2.10
Watertown, N. Y.—Analysis, 96-99% CaCO ₃ ; 50% thru 100 mesh; bags, 4.00; bulk	2.50

Agricultural Limestone (Crushed)

Alton, Ill.—Analysis 99% CaCO ₃ , 0.3% MgCO ₃ ; 50% thru 4 mesh.	3.00
Atlas, Ky.—50% thru 4 mesh.	.50
Bedford, Ind.—Analysis, 98.5% CaCO ₃ , 0.5% MgCO ₃ ; 90% thru 10 mesh	1.50
Blackwater, Mo.—Analysis, 99% CaCO ₃ ; 90% thru 4 mesh.	.75
Bridgeport and Chico, Texas—Analysis, 94% CaCO ₃ , 2% MgCO ₃ ; 100% thru 10 mesh.	1.75
50% thru 4 mesh.	1.50
Chasco, Ill.—50% thru 100 mesh.	1.20
Chico, Texas—50% thru 4 mesh; bulk	1.50

(Continued on next page)

Agricultural Limestone

Chicago, Ill.—50% thru 100 mesh; 90% thru 4 mesh.....	.80
Columbia, Krause, Valmeyer, Ill.— Analysis, 90% CaCO ₃ ; 90% thru 4 mesh.....	1.35
Cypress, Ill.—90% thru 50 mesh, 50% thru 100 mesh, 90% thru 50 mesh, 90% thru 4 mesh, 50% thru 4 mesh.....	1.35
Dundas, Ont.—Analysis, 53.8% Ca- CO ₃ ; MgCO ₃ , 43.3%. 50% thru 50 mesh; bags, \$4.75; bulk.....	3.00
Ft. Springs, W. Va.—Analysis, 90% CaCO ₃ ; 90% thru 50 mesh.....	1.50
Garnet, Okla.—All sizes.....	1.25
McCook, Ill.—Analysis, approx. 60% CaCO ₃ , 40% MgCO ₃ ; 90% thru 4 mesh.....	.90
Kansas City, Mo.—50% thru 100 mesh.....	.75
Lannon, Wis.—Analysis, 54% CaCO ₃ , 44% MgCO ₃ ; 99% through 10 mesh; 46% through 60 mesh.....	2.00
Screenings (¼ in. to dust).....	1.00
Marblehead, Ohio.—Analysis, 83.54% CaCO ₃ , 14.92% MgCO ₃ , 32% thru 100 mesh; 51% thru 50 mesh; 83% thru 10 mesh; 100% thru 4 mesh (meal) bulk.....	1.60
Mayville, Wis.—Analysis, 54% CaCO ₃ , 44% MgCO ₃ ; 50% thru 50 mesh.....	1.85 @ 2.35
Middlepoint, Bellevue, Kenton, Ohio; Monroe, Mich.; Huntington and Bluffton, Ind.—Analysis, 42% CaCO ₃ , 54% MgCO ₃ ; meal, 25 to 45% thru 100 mesh.....	1.60
Moline, Ill., and Bettendorf, Iowa— Analysis, 97% CaCO ₃ , 2% MgCO ₃ ; 50% thru 100 mesh; 50% thru 4 mesh.....	1.50
Pixley, Mo.—Analysis, 96% CaCO ₃ ; 50% thru 50 mesh.....	1.25
50% thru 100 mesh; 90% thru 50 mesh; 50% thru 50 mesh; 90% thru 4 mesh; 50% thru 4 mesh.....	1.65
River Rouge, Mich.—Analysis, 54% CaCO ₃ , 40% MgCO ₃ ; bulk.....	.80 @ 1.40
Stone City, Iowa.—Analysis, 98% CaCO ₃ ; 50% thru 50 mesh.....	.75
Tulsa, Okla.—Analysis CaCO ₃ , 86.15%, 1.25% MgCO ₃ , all sizes.....	1.25

Pulverized Limestone for
Coal Operators

Hillsville, Penn., sacks, 4.50; bulk.....	3.00
Piqua, Ohio, sacks, 4.50@5.00 bulk.....	3.00 @ 3.50
Rocky Point, Va.—80% thru 200 mesh; bags, 4.25@4.75; bulk.....	3.00 @ 3.50
Waukesha, Wis.—90% thru 100 mesh, bulk.....	4.50

Glass Sand

Silica sand is quoted washed, dried and screened unless otherwise stated. Prices per ton f.o.b. producing plant.

Berkeley Springs, W. Va.—Glass sand.....	2.25
Cedarville and S. Inland, N. J.— Damp.....	1.75
Dry.....	2.25
Cheshire, Mass.: 6.00 to 7.00 per ton; bbl.....	2.50
Columbus, Ohio.....	1.00 @ 1.50
Estill Springs and Sewanee, Tenn.....	1.50
Franklin, Penn.....	2.25
Gray Summit and Klondike, Mo.....	2.00
Los Angeles, Calif.—Washed.....	5.00
Mapleton Depot, Penn.....	2.00 @ 2.25
Massillon, Ohio.....	3.00
Mineral Ridge and Ohlton, Ohio.....	2.50
Oceanside, Calif.....	3.00
Ottawa, Ill. (Contracts).....	1.00
Pittsburgh, Penn.—Dry.....	4.00
Damp.....	3.00
Red Wing, Minn.: Bank run.....	1.50
Ridgway, Penn.....	2.50
Rockwood, Mich.....	2.75 @ 3.25
Round Top, Md.....	2.25
San Francisco, Calif.....	4.00 @ 5.00
St. Louis, Mo.....	2.00
Sewanee, Tenn.....	1.50
Thayers, Penn.....	2.50
Utica, Ill.....	1.00
Zanesville, Ohio.....	2.50

Miscellaneous Sands

City or shipping point	Roofing sand	Traction
Beach City, Ohio.....		1.75
Columbus, Ohio.....	.75 @ 1.50	
Eau Claire, Wis.....	.45 @ 1.25	
Estill Springs and Se- wanee, Tenn.....	1.35 @ 1.50	1.35 @ 1.50

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Wholesale Prices of Sand and Gravel

Prices given are per ton, F.O.B., producing plant or nearest shipping point

Washed Sand and Gravel

City or shipping point	Fine Sand, 1/10 in. down	Sand, ¼ in. and less	Gravel, ½ in. and less	Gravel, 1 in. and less	Gravel, 1½ in. and less	Gravel, 2 in. and less
EASTERN:						
Ambridge & So. H'g'ts, Penn.....	1.25	1.25	1.15	.85	.85	.85
Attica and Franklinville, N. Y.....	.75	.75	.85	.75	.75	.75
Boston, Mass.†.....	1.40	1.40	2.25		2.25	2.25
Buñalo, N. Y.....	1.10	.95			.85	
Erie, Pa.....		1.00*		1.50*	1.75*	
Farmingdale, N. J.....		.48	.75			1.10
Hartford, Conn.....	.65*					
Leeds Junction, Me.....		.50	1.75		1.35	1.25
Machias Jct., N. Y.....		.75	.75		.75	
Montoursville, Penn.....	1.00	1.00	1.00	.75	.75	.75
Northern New Jersey.....	.50 @ .60	.50 @ .60	1.00 @ 1.25	1.00 @ 1.25	1.00 @ 1.25	
Olean, N. Y.....		.75	.75	.75	.75	.75
Shining Point, Penn.....			1.00	1.00	1.00	1.00
Somerset, Pa.....		1.85 @ 2.00		1.35 @ 1.50		
South Heights, Penn.....	1.25	1.25	.85	.85	.85	.85
Washington, D. C.....	.85	.85	1.70	1.50	1.30	1.30
CENTRAL:						
Algonquin and Beloit, Wis.....	.50	.40	.60	.60	.60	.60
Attica, Ind.....			All sizes	.75 @ .85		
Barton, Wis. (f).....		.50		.75	.75	.75
Chicago, Ill.....	.70	.50	.50	.60	.60	.60
Columbus, Ohio.....		.70	.70	.70	.70	.70
Des Moines, Iowa.....	.40	.40	1.50	1.50	1.50	1.50
Eau Claire, Wis.....	.45	.45	.80	.90	.90	.90
Elgin, Ill.....	.20*	.50*	1.50*	1.50*	1.50*	1.50*
Elkhart Lake, Wis.....	.50	.50	.60	.60	.60	.60
Ferrysburg, Mich.....		.50 @ .80	.60 @ 1.00	.60 @ 1.00	.50 @ 1.25	
Ft. Dodge, Iowa.....	.85	.85	2.05	2.05	2.05	2.05
Ft. Worth, Texas.....	2.00	2.00	2.00	2.00	2.00	2.00
Grand Haven, Mich.....		.50 @ .80		.60 @ .90	.70 @ .90	
Grand Rapids, Mich.....		.50		.80	.80	.70
Hamilton, Ohio.....		1.00		.70	1.00	
Hersey, Mich.....		.50				.60
Humboldt, Iowa.....	.40 @ .60	.40 @ .60	1.40 @ 1.60	1.40 @ 1.60	1.40 @ 1.60	1.40 @ 1.60
Indianapolis, Ind.....	.60	.60	.90	.75 @ 1.00	.75 @ 1.00	.75 @ 1.00
Joliet, Plainfield and Hammond, Ill.....	.60	.50	.50	.60	.60	.60
Mason City, Iowa.....	.50	.50	1.45	1.45	1.45	1.35
Mankato, Minn.....	.55	.45		1.25	1.25	
Mattoon, Ill.....	.75	.75	.75	.75	.75	.75
Milwaukee, Wis.....		1.01	1.21	1.21	1.21	1.21
Moline, Ill.....	.60 @ .85	.60 @ .85	1.00 @ 1.20	1.00 @ 1.20	1.00 @ 1.20	1.00 @ 1.20
Northern New Jersey.....	.70	.70			1.60	
Oregon City, Ore.....		1.25	1.25	1.25	1.25	1.25
Palestine, Ill.....	.75	.75	.75	.75	.75	.75
Silverwood, Ind.....	.75	.75	.75	.75	.75	.75
St. Louis, Mo.....	1.18	1.45	1.65	1.45	1.65	1.45
Terre Haute, Ind.....	.75	.75	.75	.75	.75	.75
Wolcottville, Ind.....	.75	.75	.75	.75	.75	.75
Waukesha, Wis.....		.45	.60	.60	.65	.65
Winona, Minn.....	.40	.40	1.25	1.25	1.10	1.10
Yorkville, Sheridan, Oregon, Moronts, Ill.....		.40 @ .70	.30 @ .50	.50 @ .60	.60	.60
Zanesville, Ohio.....		.70	.50		.80	
SOUTHERN:						
Charleston, W. Va.....			All sand, 1.40.	All gravel, 1.50.		
Chattanooga, Tenn.....		1.65			1.45	
Knoxville, Tenn.....	1.00	1.20	1.20	1.20	1.20	1.20
Lindsay, Texas.....		.50			.85	
Macon, Ga.....		.90 @ 1.00	1.00	1.00	1.00	1.00
New Martinsville, W. Va.....	1.00			1.20 @ 1.30	.80 @ .90	
Roseland, La.....	.50			1.00	1.00	
WESTERN:						
Kansas City, Mo.....	.80	.70				
Los Angeles, Calif. (points all around) (d).....	.60	.50	.85	.85	.85	.85
Los Angeles district (bunkers)†.....	1.50	1.40	1.85	1.85	1.85	1.85
Phoenix, Ariz.....	1.25*	1.00*	2.50*	2.00*	1.75*	1.50*
Pueblo, Colo.....	.80	.65		1.35	1.20	1.20
San Diego, Calif.....	.65 @ .75	.65 @ .75	1.50	1.30	1.10	1.10
Seattle, Wash. (bunkers).....	1.50*	1.50*	1.50*	1.50*	1.50*	1.50*

Bank Run Sand and Gravel

City or shipping point	Fine Sand, 1/10 in. down	Sand, ¼ in. and less	Gravel, ½ in. and less	Gravel, 1 in. and less	Gravel, 1½ in. and less	Gravel, 2 in. and less
Algonquin and Beloit, Wis.....	.95					
Chicago, Ill.....	1.10	1.00				
Dudlev, Kv.....			.90			
East Hartford, Conn.....			Sand, .75*			
Ferrysburg, Mich.....						.65 @ 1.00
Gainesville, Texas.....		.95				.55
Grand Rapids, Mich.....				.60		
Hamilton, Ohio.....					.70	
Hersey, Mich.....				.55		
Indianapolis, Ind.....						
Joliet, Plainfield and Hammond, Ill.....	.35					
Lindsay, Texas.....		.95				.55
Macon, Ga.....	.35	.35				
Mankato, Minn.....						
Moline, Ill. (b).....	.60	.60				
Ottawa, Oregon, Moronts and Yorkville, Ill.....						
Roseland, La.....	.60					
St. Louis, Mo.....						
Shining Point, Penn.....						
Smithville, Texas.....	.50	.50	.50	.50	.50	.54
Summit Grove, Ind.....	.50	.50	.50	.50	.50	.54
Waukesha, Wis.....	.60	.60	.60	.60	.60	.64
Winona, Minn.....	.40	.40	.50	.60	.60	.60
York, Penn.....	1.10	1.00				

(a) ¾ in. down. (b) River run. (c) 2½ in. and less.

*Cubic yd. †Include freight and bunkering charges and truck haul. ‡Delivered on job.

(d) Less 10c per ton if paid E.O.M. 10 days. (e) pit run. (f) plus 15c winter loading charge.

Core and Foundry Sands

Silica sand is quoted washed, dried and screened unless otherwise stated. Prices per ton f.o.b. producing plant.

City or shipping point	Molding, fine	Molding, coarse	Molding, brass	Core	Furnace lining	Sand blast	Stone sawing
Aetna, Ill.	2.25	2.00	2.25	.30@.35	1.50	3.50	
Albany, N. Y.	1.50@1.75			1.00			
Arenzville, Ill.	1.75@2.25	1.75@2.25	2.00@2.50	1.75@2.25	2.00@2.50	2.00@2.50	
Beach City, Ohio	1.50@2.00	1.50@1.75		.30@1.50	1.25@2.00	2.75@4.00	1.25@1.50
Columbus, Ohio				1.25		3.00	
Eau Claire, Wis.							
Elco, Ill.							
Elnora, N. Y.							
Estill Springs and Sewanee, Tenn.	1.25			1.25		1.35@1.50	
Franklin, Penn.	1.75	1.75	2.00	2.00	2.00		
Joliet, Ill.	No. 2 molding sand; loam for luting and open hearth work—				65@.85		
Kasota, Minn.						1.00@1.25	
Klondike, Mo.	1.75		2.00	1.75	1.75		1.25
Mapleton Depot, Penn.	2.00	2.00				2.00	
Massillon, Ohio	2.50	2.50		.15@.30	2.50		
Michigan City, Ind.							
Mineral Ridge and Ohlton, Ohio	2.00*	1.75*		2.00*	1.75*	1.75*	
Montoursville, P'n.				1.25@1.35			
New Lexington, O.	2.00	1.50					
Ottawa, Ill.						3.25	
Red Wing, Minn.	1.25		1.25	1.50	1.50	3.50	1.50
Ridgeway, Penn.	1.50	1.50					
Round Top, Md.	1.25			1.60		2.25	
San Francisco, Calif.	3.50	4.75	3.50	3.50@5.00	3.50@4.50	3.50@5.00	
Tamalco, Ill.		1.40@1.60					
Tamms, Ill.							
Thavers, Penn.	1.25	1.25		2.00			
Utica, Ill.	.60	.75		.75	.75		
Utica, Penn.	1.75	1.75		2.00			
Warwick, Ohio	1.75* @2.25	1.75*		1.75* @2.25			
Zanesville, Ohio	2.00	1.50	2.00	2.00	2.00		

*Damp. †Crude silica, crushed and screened, not washed or dried. ‡Plus 75c per ton for winter loading.

Crushed Slag

City or shipping point	Roofing	¼ in. down	½ in. and less	¾ in. and less	1½ in. and less	2½ in. and less	3 in. and larger
EASTERN:							
Buffalo, N. Y., Emporium and Dubois, Pa.	2.25	1.25	1.25	1.25	1.25	1.25	1.25
Eastern Penn. and Northern N. J.	2.50	1.20	1.50	1.20	1.20	1.20	1.20
Reading, Pa.	2.50	1.00		1.25			
Western Penn.	2.50	1.25	1.50	1.25	1.25	1.25	1.25
CENTRAL:							
Ironton, Ohio	2.05*	1.30*	1.80*	1.45*			1.45*
Jackson, Ohio		1.05*		1.30*	1.30*	1.30*	1.30*
Toledo, Ohio	1.50	1.25	1.50	1.25	1.25	1.25	1.25
Youngst'n, O., dist.	2.00	1.25	1.35	1.35	1.25	1.25	1.25
SOUTHERN:							
Ashland, Ky.		1.55*		1.55*	1.55*	1.55*	1.55*
Ensley and Alabama City, Ala.	2.05	.80	1.35	1.25	.90	.90	.80
Longdale, Roanoke, Ruessens, Va.	2.50	1.00	1.25	1.25	1.25	1.15	1.15
Woodward, Ala.		.75		1.25	.90	.90	.75

*5c per ton discount on terms.

Lime Products (Carload Prices Per Ton F.O.B. Shipping Point)

	Finishing hydrate	Masons' hydrate	Agricultural hydrate	Chemical hydrate	Ground burnt lime, Blk. Bags	Lump lime, Blk. Bbl.
EASTERN:						
Berkley, R. I.			12.00			
Buffalo, N. Y.		12.00	12.00	12.00	10.00	1.95d
Chazy, N. Y.	12.50	10.50	8.00	12.00	11.50	16.50
Lime Ridge, Penn.						5.00a
West Stockbridge, Mass.	12.00	10.00	5.60			2.00t
Williamsport, Penn.			10.00			6.00
York, Penn.		9.50	9.50	11.50		8.50
CENTRAL:						
Afton, Mich.					8.50	1.61
Carey, Ohio	12.50	8.50@9.50	9.50		9.50	9.00
Cold Springs, Ohio	12.50	8.50	8.50		9.00	8.00
Delaware, Ohio	12.50	10.00	9.00	10.00		9.00
Frederick, Md.		10.00	9.50	10.00		7.50
Gibsonburg, Ohio	12.50					
Huntington, Ind.	12.50	8.50	8.50		9.00	8.00
Luckey, Ohio (f.)	12.50					
Marblehead, Ohio		8.50	8.50		9.00	8.00
Marion, Ohio		8.50	.850			1.70d
Milltown, Ind.		9.00@10.00		10.00p	8.00a	1.40r
Sheboygan, Wis.		11.50				9.50
Tiffin, Ohio					9.00	
White Rock, Ohio	12.50				9.00	11.00
Wisconsin points (f.)		11.50				9.50
Woodville, Ohio	12.50	8.00	8.00	12.50	9.00	11.00
SOUTHERN:						
Allgood, Ala.	12.50	10.00			8.50	8.50
El Paso, Tex.						1.50
Graystone, Ala.	12.50	10.00		12.50		1.75
Keystone, Ala.	12.00	10.00	10.50	10.00	9.00	8.50
Knoxville, Tenn.	20.25	10.00		10.00		1.50u
Ocala, Fla.		13.00	10.00		.80	12.00
WESTERN:						
Calcite, Colo.						9.25
Kirtland, N. M.						15.00
Limestone, Wash.	15.00	15.00	10.00	15.00	16.50	16.50
Dittlinger, Tex.		12.00@13.00			9.50p	1.50a
San Francisco, Calif.	21.00	21.00	12.50@15.00	21.00		14.50
Tehachapi, Calif.			8.00			13.00x
Seattle, Wash.	19.00	19.00	12.00	19.00	19.00	18.60

†50-lb. paper bags; (a) run of kilns; (c) wooden, steel 1.70; (d) steel; (e) per 180-lb. barrel; (f) dealers' prices; (g) to 9.50; (h) to 1.75; (i) 180-lb. net barrel 1.65; 280-lb. net barrel, 2.65 (m) finishing lime, 3.00 common; (n) common lime; (o) high calcium; (p) to 10.50; (q) to 8.50; (r) to 1.50; (s) in 80-lb. burlap sacks; (t) to 3.00; (u) two 90-lb. bags; (v) oil burnt; wood burnt 2.25@2.50; (x) wood, steel 2.30; (z) to 15.00; (*) quoted f.o.b. New York; (†) paper bags; (w) to 1.50 in two 90-lb. bags, wood bbl. 1.60; (†) to 10.00; (‡) 80-lb. paper bags; (‡) to 3.00; (‡) to 9.00; (‡) to 1.60.

Miscellaneous Sands

(Continued)

City or shipping point	Roofing sand	Traction
Gray Summit and Klondike, Mo.		1.75
Mapleton, Depot, Penn.		2.00
Massillon, Ohio		2.25
Mineral Ridge and Ohlton, Ohio	*1.75@ 2.00	*1.75
Montoursville, Penn.		1.25
Osawa, Ill.	1.25@ 1.50	
Red Wing, Minn.		1.25
Round Top, Md.	2.25	1.75
San Francisco, Calif.	3.50@ 4.50	3.50@ 4.50
Thayers, Penn.		2.25
Utica, Ill.	1.00	1.00
Warwick, Ohio		2.25
Zanesville, Ohio		2.50

Talc

Prices given are per ton f.o.b. (in carload lots only), producing plant, or nearest shipping point, Baltimore, Md.:	
Crude talc (mine run)	3.00@ 4.00
Ground talc (20-50 mesh), bags	10.00
Cubes	55.00
Blanks (per lb.)	.08
Pencils and steel worker's crayons, per gross	1.25
Chatsworth, Ga.:	
Crude Talc	5.00
Ground (150-200 mesh), bulk	12.00
Pencils and steel worker's crayons, per gross	1.00@ 2.50
Chester, Va.:	
Ground talc (150-200 mesh), bulk	9.00@10.00
Including bags	10.00@11.00
Chicago and Joliet, Ill.:	
Ground (150-200 mesh), bags	30.00
Dalton, Ga.:	
Crude talc	5.00
Ground talc (150-200) bags	10.00@12.00
Pencils and steel workers' crayons, per gross	1.00@ 1.50
Emeryville, N. Y.:	
(Double air floated) including bags; 325 mesh	14.75
200 mesh	13.75
Halesboro, N. Y.:	
Ground white talc (double and triple air floated) including bags, 300-350 mesh	15.50@20.00
Henry, Va.:	
Crude (mine run)	3.50@ 4.50
Ground talc (150-200 mesh), bulk	7.50@14.00
Joliet, Ill.:	
Ground talc (150-200) bags	30.00
Keeler, Calif.:	
Ground (200-300 mesh), bags	20.00@30.00
Natural Bridge, N. Y.:	
Ground talc (300 mesh), bags	12.00@14.00

Rock Phosphate

Prices given are per ton (2240-lb.) f.o.b. producing plant or nearest shipping point.

Lump Rock

Gordonsburg, Tenn.—B.P.L. 65-70%	4.50@ 5.00
Mt. Pleasant, Tenn.—B.P.L. 75%	6.00
Tennessee—F.O.B. mines, gross ton, unground brown rock, B.P.L. 72%	5.00
P. P. L. 72%	6.00
Twomey, Tenn.—B.P.L. 65%, 2000 lb.	7.25@ 8.25

Ground Rock

(2000 lbs.)

Centerville, Tenn.—B.P.L. 65%	7.00
Gordonsburg, Tenn.—B.P.L. 65-70%	4.00@ 4.50
Mr. Pleasant, Tenn.—B.P.L. 65%; bulk, 7.25; bags	9.25
Twomey, Tenn.—B.P.L. 65%	7.25

Florida Phosphate

(Raw Land Pebble)

(Per Ton.)

Florida—F. O. B. mines, gross ton,	
68/66% B.P.L., Basis 68%	3.00
70% min. B.P.L., Basis 70%	3.25
72% min. B.P.L., Basis 72%	4.25
75/74% B.P.L., Basis 75%	5.00
77/76% B.P.L., Basis 77%	6.00

Mica

Prices given are net, F.O.B. plant or nearest shipping point.

Pringle, S. D.—Mine run, per ton	125.00@150.00
Punch mica, per lb.	.06
Scrap, per ton, carloads	20.00
Rumney Depot, N. H.—per ton, mine run	360.00
Mine scrap	24.00
Clean shop scrap	27.00
Dry ground, 20 mesh	28.00
40 mesh	35.00
60 mesh	40.00
100 mesh	60.00
200 mesh	80.00
Roofing mica	27.00
Punch mica, per lb.	.10

Special Aggregates

Prices are per ton f.o.b. quarry or nearest shipping point.

City or shipping point	Terrazzo	Stucco-chips
Barton, Wis., f.o.b. cars		10.50
Brandon, Vt.—English pink and English cream	*11.00	*11.00
Brandon grey	*11.00	*11.00
Buckingham, Que.—Buff stucco dash		12.00@14.00
Chicago, Ill.—Stucco chips, in sacks f.o.b. quarries		17.50
Crown Point, N. Y.—Mica Spar		8.00@10.00
Easton, Penn.—Green bags included	18.00@20.00	18.00@20.00
Haddam, Conn.—Feltstone buff	15.00	15.00
Harrisonburg, Va.—Bulk marble (crushed, in bags)	12.50	12.50
Ingomar, Ohio—Concrete facings and stucco dash		6.00@18.00
Middlebrook, Mo.—Red		25.00@30.00
Middlebury and Brandon, Vt.—Middlebury white		59.00
Milwaukee, Wis.		14.00@34.00
Newark, N. J.—Roofing granules		7.50
New York, N. Y.—Red and yellow Verona		32.00
Red Granite, Wis.		7.50
Sioux Falls, S. D.		7.50
Stockton, Calif.—"Natrock" roofing grits		15.00@20.00
Tuckahoe, N. Y.		12.00
Villa Grove, Colo.		13.00
Warren, N. H.—cement facing (mica), per ton		7.50
Wauwatosa, Wis.		16.00@45.00
Wellsville, Colo.—Colorado Travertine Stone	15.00	15.00
*C.L.		
*C.L. including bags; L.C.L. 12.50.		
†C.L. including bags, L.C.L. 10.00.		

Potash Feldspar

Auburn and Brunswick, Me.—Color, white; 98% thru 140 mesh bulk	19.00
Bath, Me.—Color, white; analysis, potash, 12%; 100% thru 180 mesh, bags, 21.00; bulk	18.00
Buckingham, Que.—Color, white; analysis, K_2O , 12-13%; Na_2O , 1.75%; bulk	9.00
De Kalb Jct., N. Y.—Color, white; bulk (crude)	9.00
East Hartford, Conn.—Color, white, 95% through 60 mesh, bags	16.00
96% thru 150 mesh, bags	23.00
Erwin, Tenn.—Color, white; analysis, 12.07% K_2O , 19.34% Al_2O_3 , Na_2O , 2.92%; SiO_2 , 64.76%; Fe_2O_3 , .36%; 98.50% thru 200 mesh, bags, 16.90; bulk	15.50
Glen Tay Station, Ont., color, red or pink; analysis: K_2O , 12.81%, crude, bulk	5.75@ 7.50
Keystone, S. D.—Prime white, bulk (crude)	8.00
Los Angeles, Calif.—Color, white; analysis, K_2O , 10.35%; Na_2O , 3.62%; Al_2O_3 , 18.71%; SiO_2 , 65.48%; Fe_2O_3 , .17%; 99% thru 200 mesh, bags included, carloads	22.00
Bulk	20.00
Murphersboro, Ill.—Color, snow white; analysis SiO_2 , 64.4%; K_2O , 13%; Na_2O , 2.5%; Fe_2O_3 , 0.07%; Al_2O_3 , 19.3%; 98% thru 200 mesh, bags	22.00
Bulk	21.00

Penland, N. C.—Color, white; crude, bulk	8.00
Ground, bulk	16.50
Tenn. Mills—Color, white; analysis K_2O , 18%; Na_2O , 10%; 85% SiO_2 ; 99% thru 200 mesh; bulk	18.00
99% thru 140 mesh, bulk	16.00
Toughkenamon, Pa.—Color, white to light cream; 98% thru 150 mesh, bags, 11.00@13.00; bulk	10.00
Toronto, Can.—Color, flesh; analysis K_2O , 12.75%; Na_2O , 1.96%; crude	7.50@ 8.00
Trenton, N. J.—Crude, bulk	12.00@27.00
99% thru 140 mesh; bulk	16.00
(Bags 11 cents each, non-returnable)	
Wheeling, W. Va.—Color, white; analysis, K_2O , 9.50%; Al_2O_3 , 16.70%; Na_2O , 3.50%; SiO_2 , 69.50%; 99% thru 140 mesh, bulk	19.00

Blended Feldspar (Pulverized)

Tenn. Mills—Bulk	16.00@20.00
Afton Mich. (limestone) per ton	10.00
Belfast and Rockland, Me.—(Limestone), bags, per ton	10.00
Brandon and Middlebury, Vt., per ton	12.00
Centerville, Iowa (gypsum) per ton	18.00
Chico, Texas (limestone), 100 lb. bags, per ton	8.00@ 9.00
Los Angeles Harbor (limestone), 100-lb sack, 1.00; sacks, per ton, 8.50@ 9.50†; bulk, per ton	6.00@7.00†
Toughkenamon, Pa.—(Feldspar) 100-lb. bags, 1.00; bulk, per ton	10.00
Danbury, Conn., Rockdale and West Stockbridge, Mass.—(Limestone) bulk	7.50@9.00*
Gypsum, Ohio.—(Gypsum) per ton	10.00
Limestone, Wash. (limestone) per ton	12.50
Rocky Point, Va. (limestone) 100 lb. bags, 75c; sacks, per ton, 6.00 bulk	5.00
Seattle, Wash.—(Limestone), bulk, per ton	12.50
Warren, N. H.—(Mica) per ton	7.80
Waukesha, Wis.—(Limestone), per ton	8.00

*L.C.L.
†Less than 5-ton lots.
‡C.L.

Sand-Lime Brick

Prices given per 1000 brick f.o.b. plant or nearest shipping point, unless otherwise noted.

Barton, Wis.	10.50
Boston, Mass.	14.50
Brighton, N. Y.	*19.75
Dayton, Ohio	12.50@13.50
Detroit, Mich.	14.13
Farmington, Conn.	17.00
Flint, Mich.	*12.50@16.00
Grand Rapids, Mich.	12.00
Hartford, Conn.	*20.00
Jackson, Mich.	13.00
Lancaster, N. Y.	13.00
Madison, Wis.	14.00
Michigan City, Ind.	12.00
Milwaukee, Wis.	*13.00
Minneapolis and St. Paul, Minn.	11.25
New Brighton, Minn.	10.00
Pontiac, Mich.	11.00@12.00
Portage, Wis.	15.00
Rochester, N. Y.	19.75
Saginaw, Mich.	13.50
San Antonio, Texas	12.00@12.50
Sebawing, Mich.	12.00
Syracuse, N. Y.	20.00
Terra Cotta, D. C.	13.50
Toronto, Canada	12.00
Wilkinson, Fla.—White	12.00

*Delivered on job. †Delivered in city limits.
‡Less 5%. †Dealers' price. (a) Less 1.00 E.O.
M. 10 days.

Portland Cement

Prices per bag and per bbl, without bags net carload lots.

	Per Bag	Per Bbl.
Albuquerque, N. M.		3.47
Atlanta, Ga.		2.35
Baltimore, Md.	1.70@2.35	
Birmingham, Ala.		2.30
Boston, Mass.	1.81@2.63	
Buffalo, N. Y.	1.67@2.38	
Butte, Mont.	.90‡	3.61
Cedar Rapids, Iowa		2.34
Charleston, S. C.		2.35
Cheyenne, Wyo.	.82‡	3.31
Cincinnati, Ohio		2.37
Cleveland, Ohio		2.29
Chicago, Ill.	21.0@2.60	
Columbus, Ohio		2.34
Dallas, Texas		2.10
Davenport, Iowa		2.29
Dayton, Ohio		2.38
Denver, Colo.	.66‡	2.65
Detroit, Mich.		2.15‡
Duluth, Minn.		2.09
Houston, Texas		2.60
Indianapolis, Ind.		2.29
Jackson, Miss.		2.60
Jacksonville, Fla.		2.35
Jersey City, N. J.	1.85@2.33	
Kansas City, Mo.	2.02@2.42	
Los Angeles, Calif.	.61†	2.44†
Louisville, Ky.		2.27
Memphis, Tenn.	2.80@3.00	
Milwaukee, Wis.		2.25
Minneapolis, Minn.	2.32@2.72	
Montreal, Que.		1.90
New Orleans, La.		2.20
New York, N. Y.	1.77@2.25	
Norfolk, Va.		2.17
Oklahoma City, Okla.		2.86
Omaha, Neb.		2.76
Peoria, Ill.		2.27
Philadelphia, Penn.	1.85@2.41	
Phoenix, Ariz.		3.70
Pittsburgh, Penn.		2.09
Portland, Colo.		2.80
Portland, Ore.		3.20
Reno, Nevada	.75‡	3.01
Richmond, Va.	1.69@2.44	
Salt Lake City, Utah	.70‡	2.81
San Francisco, Calif.		2.31
Savannah, Ga.		2.50
St. Louis, Mo.	.55	2.20
St. Paul, Minn.		2.32
Seattle, Wash.	10c discount	2.65
Tampa, Fla.		2.60
Toledo, Ohio		2.20
Topeka, Kans.		2.65
Tulsa, Okla.		2.73
Wheeling, W. Va.		2.17
Winston-Salem, N. C.		2.78

NOTE—Add 40c per bbl. for bags.
†Delivered on job in any quantity, sacks extra.
‡Ten cent discount to dealers.

Mill prices f.o.b. in carload lots, without bags, to contractors.

	Per Bag	Per Bbl.
Buffington, Ind.		1.85
Chattanooga, Tenn.		2.45*
Concrete, Wash.		2.35
Davenport, Calif.		2.05
Detroit, Mich.		2.15
Hannibal, Mo.		2.05
Hudson, N. Y.		2.05
Leeds, Ala.		1.95
Mildred, Kans.		2.35
Nazareth, Penn.		1.95
Northampton, Penn.		1.95
Richard City, Tenn.		2.05
Steeltown, Minn.		1.90
Toledo, Ohio		2.20
Universal, Penn.		1.85

*Including sacks at 10c each.

Gypsum Products—CARLOAD PRICES PER TON AND PER M SQUARE FEET, F. O. B. MILL

	Crushed Rock	Ground Gypsum	Agri-cultural Gypsum	Stucco Calced Gypsum	Cement and Gauging Plaster	Wood Fiber	White Gauging	Sanded Plaster	Keene's Cement	Trowel Finish	Plaster Board— 4x32x 36" Wt. 36" Wt. 1500 lb. Per M Sq. Ft.	Wallboard, 4x32 or 48" Lgths 6'-10', 1850 lb. Per M Sq. Ft.
Arden, Nev. and Los Angeles, Calif.	3.00	8.00u	8.00u	10.70u	10.70u	10.00	12.00			11.70u		
Centerville, Iowa	2.75	12.00			10.00	11.30				13.00		
Detroit, Mich.†				11.30	11.30	8.00	8.25@9.40				.14‡s	40.00@41.00
Delawanna, N. J.			7.00			15.50d	18.50		30.00	15.50		
Douglas, Ariz.			6.00	8.00	9.00	9.00	17.50		24.55	20.00		
Grand Rapids, Mich.	2.75	6.00	6.00	9.00	9.00	9.00	19.00	7.00	27.00	20.00	15.00	30.00
Gypsum, Ohio‡	3.00	4.00	6.00	9.00	9.00							
Hanover, N. H.			11.80									
Los Angeles, Calif.			10.30k									
Port Clinton, Ohio	3.00	4.00	6.00	10.00	9.00	9.00	21.00	7.00	30.15	20.00	20.00	30.00
Portland, Colo.			10.00									
San Francisco, Calif.			13.40r	14.40r			15.40r					
Seattle, Wash.	6.50		11.00	16.00								
Sigard, Utah									18.00a			
Winnipeg, Man.	5.00	5.00	7.00	13.00	14.00	14.00					20.00	25.00
												33.00

NOTE—Returnable bags, 10c each; paper bags, 1.00 per ton extra (not returnable).

†To 3.00; ‡to 11.00; §to 12.00; †prices per net ton, sacks extra; (a) to 25.00; (b) net; (c) gross; (d) hair fibre; (f) delivered; (h) delivered in six states; (i) delivered on job; (k) sacks 12c extra, rebated; (m) includes paper bags; (n) includes jute sacks; (r) including sacks at 15c; (s) per board; (t) to 16.50; (u) includes sacks; (v) F.O.B. N. Y. C. and dealers yard in mill locality.

Market Prices of Cement Products

Concrete Block

Prices given are net per unit, f.o.b. plant or nearest shipping point

City of shipping point	Sizes		
	8x8x16	8x10x16	8x12x16
Camden, N. J.	17.00		
Columbus, Ohio	.16@.18a		
Detroit, Mich.	19.00†		28.00‡
Forest Park, Ill.	18.00*	23.00*	30.00*
Grand Rapids, Mich.	.16		
Graettinger, Iowa	.18@.20		
Indianapolis, Ind.	.14@.16†		
Los Angeles, Calif.	5 3/4 x 3 1/2 x 12—55.00	7 3/4 x 3 1/2 x 12—65.00	
Oak Park, Ill.	.18@.21a		
Olivia and Mankato, Minn.	9.50b		
Somerset, Pa.	.20@.22		
Yakima, Wash.	20.00*		

*Price per 100 at plant. †Rock or panel face. (a) Face. ‡Delivered. ¶Price per 1000. (b) Per ton.

Cement Roofing Tile

Prices are net per sq. in carload lots, f.o.b. nearest shipping point unless otherwise stated. Camden and Trenton, N. J.—8x12, per sq.

Red	15.00
Green	18.00
Chicago, Ill.—per sq.	20.00
Cicero, Ill.—Hawthorne roofing tile, per sq.	
Chocolate	Yellow, Tan
Red and Orange	Green and Slate
Blue	Gray
French and Spanish	\$11.50 \$13.50 \$12.75
Ridges (each)	.25 .35 .30
Hips	.25 .35 .30
Hip starters	.50 .60 .60
Hip terminals, 2-way	1.25 1.50 1.50
Hip terminals, 4-way	4.00 5.00 5.00
Mansard terminals	2.50 3.00 3.00
Gable finials	1.25 1.50 1.50
Gable starters	.25 .35 .30
Gable finishers	.25 .35 .30
End bands	.25 .35 .30
Eave closers	.06 .08 .06
Ridge closers	.05 .06 .05

*Used only with Spanish tile.

†Price per square.

Houston, Texas.—Roofing Tile, per sq.

Red	17.00
Green	19.50
Indianapolis, Ind.—9"x15"	
Gray	10.00
Red	11.00
Green	13.00
Waco, Texas:	Per sq.
4x4	.60

Cement Building Tile

Cement City, Mich.—5"x8"x12", per M	55.00
Detroit, Mich.—5x8x12, per 100	8.50
Longview, Wash.—(Stone Tile)	Per 1000
4x6x12	55.00

Concrete Brick

Prices given per 1000 brick, f.o.b. plant or nearest shipping point.

	Common	Face
Appleton, Minn.	22.00	25.00@35.00
Baltimore, Md. (Del. according to quantity)	15.50	22.00@50.00
Camden and Trenton, N. J.	17.00	
Ensley, Ala. ("Slag-tex")	14.50	22.50@33.50
Eugene, Ore.	25.00	35.00@75.00
Friesland, Wis.	22.00	32.00
Longview, Wash.	20.00	

	Common	Face
Milwaukee, Wis.	15.00	33.00@42.00
Mt. Pleasant, N. Y.	18.00	14.00@23.00
Omaha, Neb.	12.50	30.00@40.00
Pasadena, Calif.	15.25	21.50
Philadelphia, Penn.	17.00	25.00@75.00
Portland, Ore.	14.00	22.50
Prairie du Chien, Wis.	18.00	25.00@40.00
Rapid City, S. D.	16.50	32.50@125.00
Waco, Texas	20.00	35.00
Watertown, N. Y.	14.00	20.00@42.00
Wauwatosa, Wis.	14.00	22.00
Winnipeg, Man.	22.50	
Yakima, Wash.		
†Gray. †Red.		

Current Prices Cement Pipe

Prices are net per foot f.o.b. cities or nearest shipping point in carload lots unless otherwise noted.

	4 in.	6 in.	8 in.	10 in.	12 in.	15 in.	18 in.	20 in.	22 in.	24 in.	27 in.	30 in.	36 in.	42 in.	48 in.	54 in.	60 in.
Detroit, Mich.									\$14.00 per ton								
Graettinger, Iowa	.04 1/2 d	.05 1/2	.08 1/2	.13	.17 1/2		.50	.60	.75	.85							
G'd Rapids, Mich. (b)				.60	.72	1.00	1.28			1.92	2.32	3.00	4.00	5.00	6.00		
Houston, Texas		.19	.24	.43	.55 1/2	.90	1.30		†1.70	2.20							
Indianapolis, Ind. (a)				.80	.90	1.10	1.30			1.70							
Longview, Wash.																	
Mankato, Minn. (b)																	
Olivia & Mankato, Minn.										1.50	1.75	2.50	3.25	4.25			
Paullina, Iowa†								2.25		2.11		2.75	3.58		6.14		7.78
Somerset, Pa.					.80†	1.00‡	1.40‡			2.00‡		3.25‡	4.00‡	6.00‡			
Tacoma, Wash.	.15	.18	.22 1/2	.30	.40	.55	.80										
Tiskilwa, Ill. (rein.) (a)				.65	.75	.85	1.10	1.60		1.90				3.40			
Wahoo, Neb. (b)					1.00	1.13	1.42			2.11		2.75	3.58	4.62	6.14	6.96	7.78
Waukesha, Wis.																	
Yakima, Wash.																	

*30-in. lengths up to 27-in. diam., 48-in. lengths after; (a) 24-in. lengths; (b) Reinforced; (c) Interlocking bar reinforced. †21-in. diam. ‡Price per 2 ft. length. (d) 5 in. diam. †@1.08. ‡@1.25. ‡@1.65. *@2.50. *@3.85. *@5.00. †@7.50.

Rock Products Industries Active About Memphis

THE various sand pits and quarries in West Tennessee and along the rivers of the valley in the Memphis section are fairly active at this season. The rains this spring have been light but in some of the streams a deep water prevails from upper water courses. The Wolf River Sand Co. in North Memphis are working several boats and many teams every day this spring in their sand operations. The lime plants in the Tennessee river section, Houston and Dickson county, Tennessee, are quite active. Building materials trades all report busy conditions.

Expand Plant of the Alabama Sand and Gravel Company

PLANS for building a new washing plant and additional railroad track are under way at the plant of the Alabama Sand and Gravel Co., Montgomery, Ala. The company has also recently purchased three new locomotives. The new plant which will probably be completed within a few months is expected to greatly increase the present production of about 2500 cu. yd. daily of washed and graded sand and gravel.

New Bedford, Mass., Awards Contracts for Road Materials

W. P. HAMMERSLEY superintendent of street department, New Bedford, Mass., has awarded the contracts for road materials to be used by the department for the current year. All awards were made on the basis of delivery on the job as required. The successful bidders were: Roger T. Fay, New Bedford—crushed stone (trap rock)—\$2.88 per ton. Portland cement—T. A. Denault, New Bedford—79 1/2 c per bag (delivered) or 77 1/2 c at the warehouse, both prices less a 10c rebate on returnable bags. G. E. Tripp, New Bedford—gravel (unscreened)—\$1.00 per ton. Sullivan Granite and Construction Co., New Bedford—gravel (screened)—\$1.65 per ton. O'Connor Bros. and Sullivan Granite and Construction Co.—sand at \$1.05 per ton.

Merger of New Orleans Gravel Plants

Newspapers Attack New Company as a Combination in Restraint of Trade

THE Phoenix Sand and Gravel Co. of New Orleans has been formed by a number of producers of that city. It is incorporated in the usual form for \$50,000, the main purposes set forth in the articles of incorporation being the sale and production of sand and gravel. The incorporators are said to represent about all the production within the 3-cent freight rate limit near New Orleans, and the company was at once attacked by the newspapers as a combination in restraint of trade.

In a letter to ROCK PRODUCTS the secretary of the company writes of the purposes of the organization as follows:

"The Phoenix Sand and Gravel Co. is a wholesale concern, buying gravel and sand for resale. The plants have agreed to sell, and we have agreed to purchase, their entire output. We sell material to our customer and send an order to the plant which makes the shipment and invoices us. We in turn invoice our customer just as would any other wholesale concern. We pass upon the credit, assume all obligations and pay the plants in accordance with agreed terms.

"What we are able to accomplish is to minimize selling and accounting expense, and instead of wasting our surplus energy in destructive competition we will give our customers the utmost in quality and service and develop new fields and if possible new uses for the product we have to sell.

"Because we will be able to increase our volume and reduce our cost of distribution we will be able to sell gravel and sand at a profit to the plants and at a reduced price to the customer."

The first board of directors named in the articles of incorporation consisted of: Paul F. Jahnke, Walter Green, H. D. Dear, H. J. Cowgill, G. W. Prutsman, O. O. Ogden, J. F. Calmes, O. Schwartz, H. H. Holloway, A. D. Danziger, S. L. Cooper and A. D. Alderson.

The newspapers charged that the new company had raised the price of gravel (delivered on the job) from \$2.50 to \$3.50 per yard, and the price of sand (delivered) from \$1.50 to \$2.50 per yard.

An attack was announced to be begun by the city attorney asking that a permit to incorporate be refused and that the incorporators be indicted under the state act on the ground of restraint in trade.

Later newspaper clippings indicate that the antagonism aroused has subsided to a great degree. As regards price, the claim

that prices would be unduly raised has been withdrawn. The city attorney is quoted in the *New Orleans Tribune* as saying that he understood that the price of gravel would be \$1 per ton at the pit, loaded on cars, which compares very favorably with the price of gravel elsewhere throughout the United States. Apparently no investigation is to be begun by federal authorities.

The organization is along the same lines as the Buffalo (N. Y.) Gravel Corp., which was described in ROCK PRODUCTS, June 7, 1919. This organization was attacked with even greater violence and was investigated by state and federal authorities, but withstood attacks and was declared not to be a combination in restraint of trade. The verdict finding the incorporators not guilty of trying to create a monopoly was rendered by a jury June 6, 1923. The indictment followed an investigation by the Lockwood committee of the New York state legislature.

As in the case of the Buffalo corporation, the New Orleans merger will in the end prove of advantage to consumers as well as producers of sand and gravel. The distributing organization by combining the work of several former competitors can systematize delivery work, eliminate the cost of duplicate sales effort and in other ways effect large economies which will eventually benefit the consumer.

Portland Cement Association Moves To Its New Home

THE general offices of the Portland Cement Association, which for the past 10 years have been in the Conway building, 111 West Washington street, Chicago, have been moved to the association's new building, Grand avenue and Dearborn street, otherwise known as 33 West Grand avenue. The entire building is occupied by the Portland Cement Association and its research laboratory, which has been located in the Lewis Institute heretofore and conducted co-operatively.

The architects, Holabird and Roche, have produced a handsome five-story and two-basement building, resting on 30 concrete caissons carried down to firm bearing. This structure is regarded by engineers, architects and builders as representing the highest type of fire resistive construction and also as a worthy addition to the rapidly growing list of structures which typify the architectural possibilities of concrete.

The Turner Construction Co. of Chicago and New York, which was awarded the contract for this building, began excavation in August. The greater portion of the work was carried on during cold weather. The usual precautions of heating aggregates and protecting concrete from freezing were followed. Floor by floor, the building was enclosed with tarpaulins and heated with salamanders. As a matter of fact, winter temperatures were in no sense a handicap to the orderly and scheduled progress of the work.

Foundation design provides for adding stories to the building if enlargement of association activities demands more space.

The sub-basement contains the heating, mechanical and electrical equipment servicing the building. The heavier laboratory testing machines are installed in the basement proper, which also contains moist rooms and other facilities for storing the thousands of concrete cylinders which month by month and year by year as they are submitted to test disclose the results of the many carefully planned researches constantly being conducted.

Other laboratory equipment, a laboratory machine shop, shipping and receiving rooms for the building, reception room, information desk and telephone switchboard are on the first floor. The lobby is a revelation to those unfamiliar with the possibilities of precast concrete stone. Lighting in the reception room is from flood lights, mounted on precast concrete standards.

The precast stone stairway leading to the second floor contributes to other architectural attractions of the lobby. On the second floor is the chemical laboratory and the offices of the director of research and his assistants. The general storage facilities for bulletins, records, etc., are also on this floor. In addition there is a small auditorium and stage.

The third floor is devoted to offices of the structural, railways and cement products bureaus and to the association's reference library. Stenographic and mailing departments are on the fourth floor.

The offices of the general manager, assistant general manager and several of the general office bureaus are on the fifth floor. There is also a conference room for staff meetings.

Hugh McCaughn New Superintendent of Penn Plant of Charles Warner Company

THE Charles Warner Co., Wilmington, Del., has appointed Hugh McCaughn superintendent of the Penn plant, to succeed James A. Mundy, II, who recently resigned. Mr. McCaughn was formerly night superintendent of the Manor plant. Maurice Caven has been appointed to fill the vacant position of night superintendent at the Manor plant and William Beninj made night foreman.

New Machinery and Equipment

A New Loader Mounted on Crawler Treads

BARBER-GREENE CO., Aurora, Ill., have recently put on the market a new bucket loader known as Model 25. The new model is mounted on crawler treads and is operated by either gasoline or electric motor. A General Electric Co. 10 hp. motor with r.p.m. to suit the characteristics of the available current or a Continental gasoline power unit, P-20, a four cylinder engine is furnished. All engine accessories are said to be of a good make. Warner auto-truck transmission is used with the machines driven by a gasoline engine, and a Midship-type auto-truck transmission is used with electric motor drive.

The following speeds are said to be obtained: Low, 30 ft. per minute; second, 80 ft. per minute; high, 100 ft. per minute and

reverse, out of the material, 26.5 ft. per minute. These vary slightly with electric motor on account of the different ratios in the transmission.

The boom is mounted on a curved track and power is transmitted from the main jack shaft through a single strand of steel bushed roller chain to a safety sprocket with breaking bolt on the head shaft. The head shaft is 14 ft. 9 $\frac{3}{4}$ in. from the ground.

The buckets are 12 in. by 8 in., made of malleable iron spaced 18 in. centers on two strands of chain, running on chilled head and foot sprockets.

The weight of the machine is said to be about 9500 lb. and its capacity about 1 cu. yd. per minute in free flowing material. The hopper is of strike-off type of 14 cu. ft. maximum capacity or the overflow type of 12 cu. ft. capacity. The Alemite lubrication system is used throughout.



A new type of truck loader which is on crawler treads and which may be powered with gasoline or electric motor as desired

New Electric Car Spotter

A NEW vertical-capstan electric car spotter, a compact motor driven unit, has been announced by H. W. Caldwell and Son Co., Chicago, Ill. The operation of the car spotter appears simple; one end of a rope or cable is attached to the car or other object to be moved and several turns of the other end wound around the capstan and the power turned on. It is claimed that a 20-lb. pull

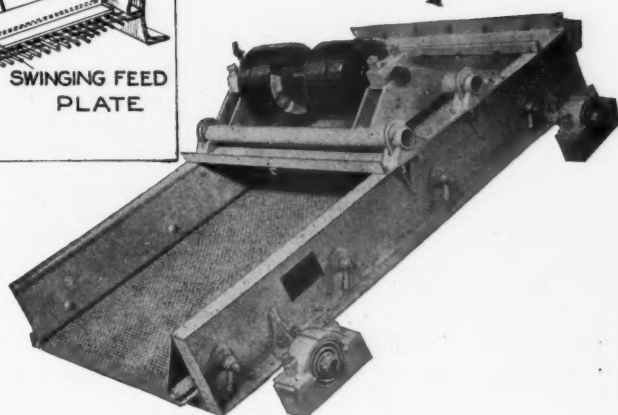
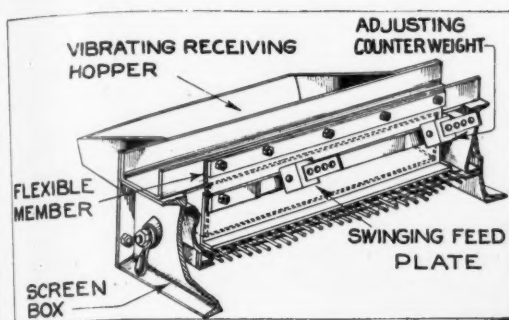


Car spotter with vertical capstan

on the capstan will move a ton of weight on a straight track. Many other uses for the device are made possible, it is said, because of the 360 deg. working radius of the capstan which further permits reduction of hand labor in pulling and hauling jobs.

The upper bearing of the vertical capstan shaft is said to be especially long, to take the pressure from the rope pull. The capstan has a large flange on the lower edge, the radius of which allows it to fit over the end of the bearing. This is said to reduce the bending moment of the shaft. A cut steel spur pinion mounted on the motor shaft meshes with a cut cast iron spur gear on the worm shaft. The worm is of hardened steel, integral with the shaft, running in roller bearings, and with a ball bearing for taking up the end thrust. These bearings are mounted in a cast iron frame, which is bolted to a cast iron center, and there is a bronze thrust washer between the hub of the worm gear and the lower bearing of the vertical shaft. An automatic oiling system is used for lubrication of gears, etc., and grease cups provided for the upper bearing of the vertical shaft.

The car spotter is made in two sizes, No. 1 and No. 2. The former size is said to have a speed of 40 to 60 ft. per minute, while moving one, two or three cars; and the latter size is said to move between three and six cars 26 to 42 ft. per minute.



Vibrating screen with improved feeding arrangements

Improvement to Vibrating Screen

THE cut shows an improvement made by the Link-Belt Co. to its well known vibrating screen. The purpose is to insure uniform and evenly distributed feed.

The feed falls into a vibrating receiving hopper and passes out over a swinging feed plate to the screen. The amount of vibration may be adjusted by a flexible counterweight.

All plant operators recognize that a screen gives the greatest efficiency and the cleanest product when it is fed with a uniform quantity of material evenly distributed. The new feeding arrangement should add considerably to the capacity of the screen.

Steering Method for Crawlers

THE Northwest Engineering Co., Chicago, Ill., builders of gasoline, electric and Diesel powered shovels, cranes and draglines, claim a crawler mobility unequalled by any other design. This design is patented and is an exclusive feature with Northwest machines. It is said to be different from other crawlers in that full power is maintained on both crawler sides while turning as well as while going straight ahead.

The Northwest method is to slow either crawler down, turning it in a gradual curve leaving full driving power on both sides. Thus it is claimed that as the tread on the inside is moving under power there is a forward lifting effort instead of its being forced through the surface crust. As both crawlers are alive there is said to be no increase in dead weight while turning and for this reason a crawler of this design is said to be able to turn with 100% steering power instead of the 50% loss where one side is blocked.

This combination of crawler design and

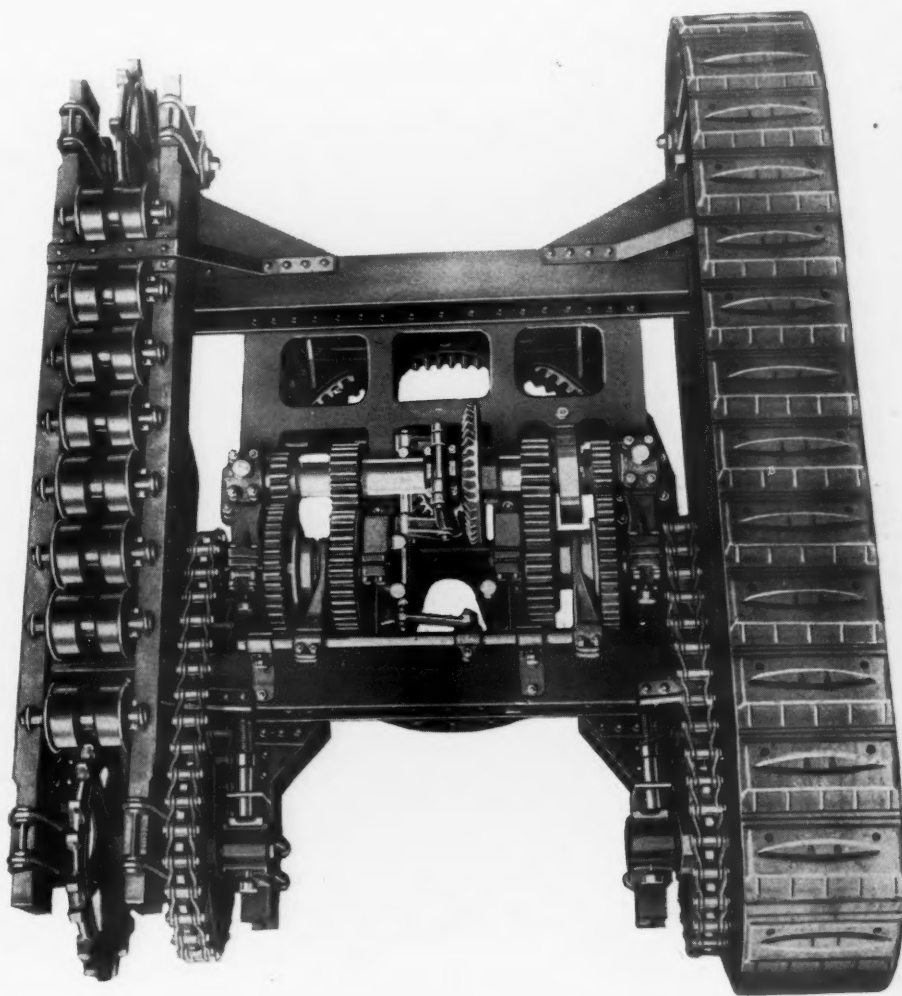
not strain the machine, tear up the ground or pavement and can be kept on the road more easily. There is said to be ample clearance beneath the machine so that if the crawler sinks into soft earth there is nothing



Shovel with new steering gear.

steering efficiency is said to increase mobility and speed. The makers say that though it is possible to stop one crawler for making a sharp turn, operators prefer the shockless turn as it is said to be sure, does

to drag on high centers. This is accomplished by a greater height of crawler which also, it is claimed, makes a more even belt action and freedom from slapping action as the treads strike the ground.



With this mechanism it is claimed that the same power is maintained in turning as when the machine is going straight ahead

Clinker Conveying Equipment at Peerless Cement Plant

By R. A. Shelbauer
Of Chain Belt Company, Milwaukee

THREE super-capacity conveyors handle the hot and cold clinker from kiln to storage and storage to finish mills at the new 4500 bbl. plant of the Peerless Portland Cement Co. on the River Rouge, Detroit, Mich. This cement clinker conveying equipment was built by the Chain Belt Co. of Milwaukee. A. F. Miller was the consulting engineer.

The equipment consists of three units, one for conveying hot cement clinker and two units for conveying cold cement clinker.

The "Rex" hot clinker conveyor passes through a tunnel under the kiln room floor.

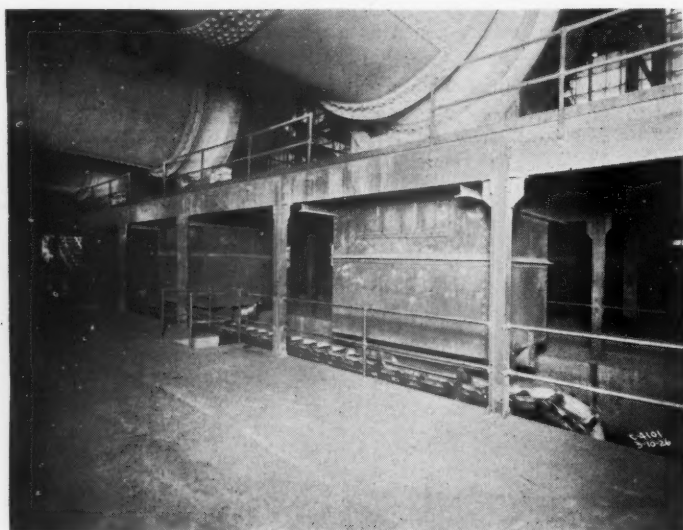
It receives the hot clinker from three kilns and carries it in 18 in. by 24 in. malleable iron overlapping pans mounted on Chabelco steel chain to the storage yard. The horizontal length of this conveyor is 116 ft. and it rises outside of the kiln building at an angle of 25 deg. to a height of 24 ft. at the discharge end. The conveyor is driven by a 10 h.p. motor at a speed of 30 ft. per minute, delivering clinker to the storage pile at the rate of 90 tons per hour.

The hot clinker after being discharged from the conveyor is spread over the storage yard by means of an overhead traveling

crane. After it has cooled sufficiently it is loaded by the same crane into a series of hoppers located over the cold clinker conveyor tunnel which passes under the storage yard.

The cold clinker conveyor which carries the cold clinker from the storage yard to storage hoppers is 367 ft. long and at the discharge end rises on an incline of 28 deg. to a height of 24 ft. The material is carried in 12 in. pitch by 30 in. wide, double beaded steel pans mounted on Chabelco steel chain and driven by a 25 h.p. motor at a speed of 50 ft. per minute with a capacity of 90 tons per hour.

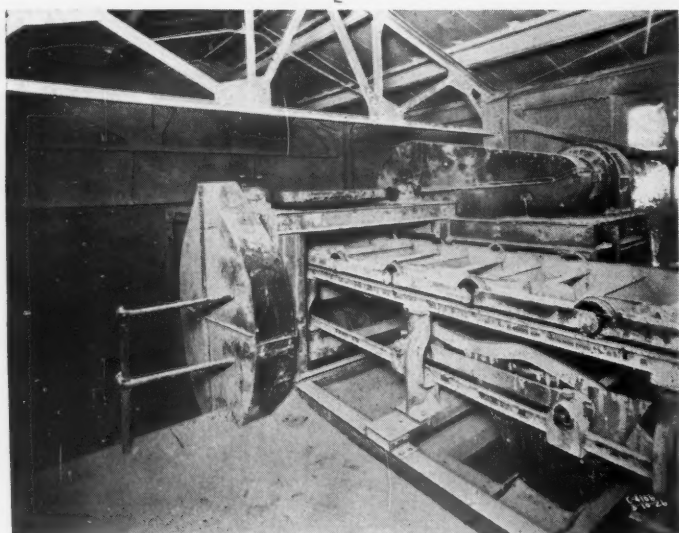
The clinker is discharged from this conveyor into two 9 ft. square storage hoppers having a capacity of 50,000 lbs. each. Directly beneath the storage hoppers two 5 ft. square weigh hoppers, each of 10,000 lb. capacity, are suspended on two 16,000 lb. Fairbank-Morse overhead pipe lever scales with type registering beams. Both the stor-



Pan conveyor showing horizontal run in trench underneath discharge hoppers of kilns—conveyor shown in motion carrying red-hot clinker



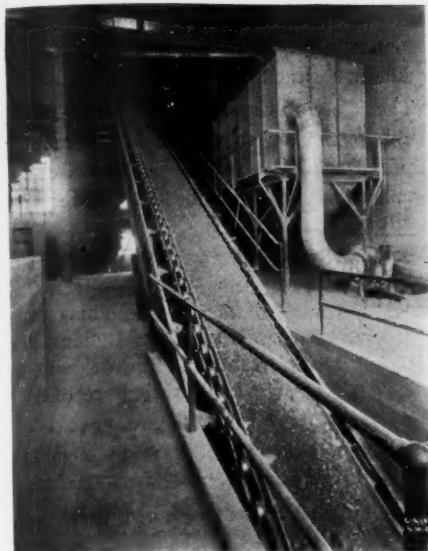
Incline section of same pan conveyor shown in view at the left—crane for handling clinker discharge shown in the background



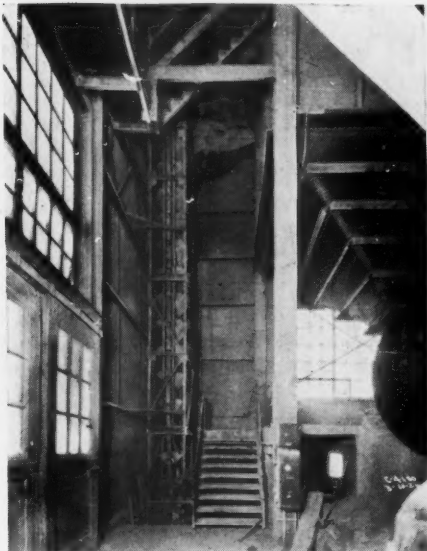
Head end and part of driving mechanism of pivoted bucket conveyor which handles cold clinker from weigh hoppers to storage bins over grinding machines



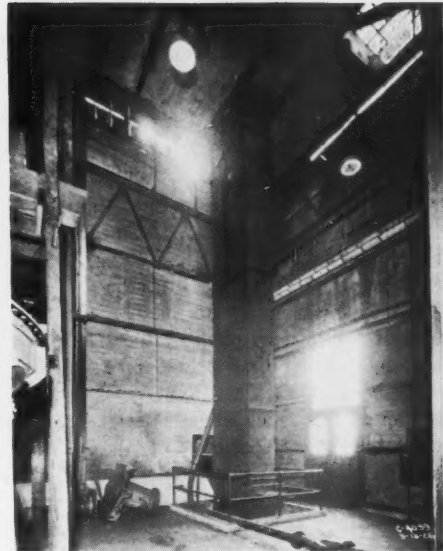
Section of horizontal run of pivoted bucket conveyor looking toward take-up end, and a part of the vertical run on descending scale



Pan conveyor for cold clinker discharging to storage bin over weighing hoppers



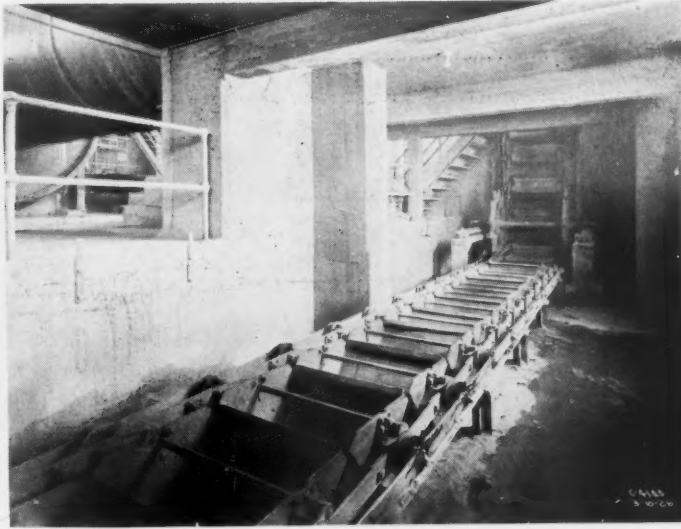
Vertical run of pivoted bucket carrier on descending side feeding cold clinker to hoppers



Bucket elevator in coal-grinding plant—fed by a screw conveyor



Upper horizontal run of pivoted bucket carrier looking toward the ascending side of vertical run—Two buckets shown in engagement with tripper



Lower horizontal run of pivoted bucket conveyor looking toward bucket feeders underneath the weighing hoppers

age hoppers and weigh hoppers are lined with $\frac{1}{2}$ in. thick white iron wearing plates and fitted with manganese steel undercut gates made dust-tight by flexible canvas housings. The operating levers for the undercut gates of the storage and weigh hoppers are placed in a position near the scale beams to enable the operator to watch the beam when operating the gates. After weighing, the clinker passes out of the weigh hoppers into the pivoted bucket conveyor.

The "Rex" pivoted bucket carrier which receives the clinker from the weigh hoppers consists of 24-in. by 30-in. malleable iron buckets mounted on Chabelco steel chain, driven by a 15 h.p. motor at a speed of 30 ft. per minute with a capacity of 90 tons per hour. The distance between the horizontal centers of this conveyor is 110 ft. and the vertical centers 37 ft. The upper horizontal run passes over four 20 ft.

square hoppers with two stationary trippers placed over each hopper for discharging the material into the hoppers.

The chain sprockets on the drive shafts of each conveyor are made up of cast iron spiders on which are mounted cast steel sprocket teeth in segments of one tooth for hot clinker and pivoted bucket conveyors and two teeth for cold clinker conveyor and these tooth segments are made reversible, giving a double life to the sprocket and making it possible to replace the teeth without having to remove the sprockets from the shafts.

[The above is an interesting example of the care and skill employed in modern cement plants to design not only the essential machines, such as kilns and grinding mills, but also the accessory machines which are important in securing continuous operation. —Ed.]

Sanderson-Cyclone Company Buys Wellman-Seaver- Morgan Motors

ACCORDING to a recent announcement, the motor division of the Wellman-Seaver-Morgan Co., Cleveland, Ohio, operated at Akron, Ohio, has been purchased in its entirety by the Sanderson-Cyclone Drill Co., Orrville, Ohio.

In the agreement covering this purchase, all drawings and patterns, special machinery, tools and jigs, inventory and good-will of W-S-M engines have been transferred to the Sanderson company and all the physical property has been moved to their new factory at Orrville, Ohio, where the engines are now being built and serviced.

All the former heads of the engineering and manufacturing department of the acquired company have been retained and will occupy the same capacities.

Union Rock Company Acquires Three More Plants

THE Union Rock Co., Los Angeles, Calif., has recently purchased several stations as a further step in the service station program of the company, according to Walter Moore, Jr., sales manager of the concern.

This expansion program includes the purchase of the modern plant of the Boulevard Sand and Gravel Co., located on San Fernando boulevard. The property comprises 88 acres and includes what is declared to be one of the finest deposits in the valley. The plant is practically new. It has complete washing facilities as well as crushing and

conveying machinery, with a capacity of 200 tons an hour and a stock pile of 50,000 tons, according to Mr. Moore. This plant is now sending materials by truck to Hollywood and other points nearby, besides shipping in carload lots as far north as Santa Barbara. A spur is being run into the bunkers from the main line of the Southern Pacific, to facilitate the loading of cars at the plant without truck hauling.

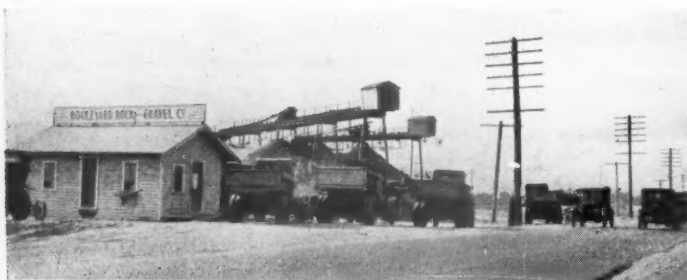
A second acquisition of the Union Rock Co. is the plant of Fewell and Webb at Hermosa Beach, which has a capacity of 1500

tons, taking care of a territory including Redondo, Torrance, Hermosa Beach and Manhattan Beach.

The Culver City plant of Fewell and Webb forms the third link in the recently acquired stations. This is a 2000-ton capacity plant serving the immediate Culver City territory.

Both of the former Fewell and Webb plants are being equipped with standard scales in charge of certified weighing masters. By this installation these stations, like all other Union Rock Co. stations, will be enabled to furnish exact weight certificates with all materials sent out.

It has been announced that the company in addition to buying these plants is making improvements on its other plants.



Left—Plant of the Boulevard Rock and Gravel Co. recently acquired by the Union Rock Co. Right—Storage system and stock piles at the Boulevard plant

Now 27 Service Stations for Users of Sand, Rock and Gravel!

NOW, you can place your orders with UNION ROCK COMPANY and receive SHORT-HAUL, PROMPTNESS at points in the territory surrounding these three new stations:

BOULEVARD ROCK & GRAVEL COMPANY PLANT • • •
San Fernando Valley, San Fernando Road and Brentford Avenue. Telephone Burbank 615.

CULVER CITY BUNKERS • • • • •
Wadsworth and Hayes Avenues. Telephone Elmore 1415.

HERMOSA BEACH BUNKERS • • • • •
Second Street between Santa Fe and P. E. Trucks. Telephone Redondo 1102.

1. SIXTEENTH STREET Bunkers WEstmore 4041
2. TWENTIETH STREET Bunkers WEstmore 2363
3. MERRILL AVENUE Bunkers DElaware 5157
4. VINEYARD Distributing Station WHittier 3616
5. ARROYO SECO Bunkers CApital 2471
6. SLAUSON AVENUE Bunkers VErmont 5362
7. SHERMAN Bunkers OXFord 5716
8. BRUSH CANYON Plant HOLLYwood 0374
9. HOME JUNCTION Bunkers Santa Monica 31497; 31498
10. CULVER CITY Plant Culver City 2892
11. COMPTON Bunkers Compton 1641
12. McDONALD Bunkers (San Pedro District) Long Beach 33965
13. LONG BEACH Bunkers Whittier 14294
14. LOS NIETOS Bunkers El Monte 170
15. EL MONTE Bunkers El Monte 170
16. DURBIN Plant
17. BALDWIN PARK Plant
18. CRUSHTON Plant
19. RIVAS Plant
20. LARGO Plant
21. KINCAID Plant
22. CLAREMONT Plant
23. WISEBURN Bunkers Building
24. WILMINGTON Bunkers Building (Harbor District)

UNION ROCK COMPANY

EXPERIENCE COUNTS
George A. Rogers, President
L. L. Rogers, Vice-President
Harry Lee Martin, Vice-President

The Officers of this Company are:
R. E. Rogers, Secretary
T. C. Rogers, Treasurer
Walter Moore, Jr., Manager of Sales

BUILD for Permanence
with
UNION ROCK PRODUCTS

An advertisement of the Union Rock Co. which shows the facilities for making deliveries anywhere in the Los Angeles district

Southwestern Division of the National Crushed Stone Association Organized

HAVING for its purpose the standardizing of crushed stone, the increasing of its use and the rendering of better service to consumers, temporary organization of the Southwestern division of the National Crushed Stone Association has just been formed at Austin, Texas, with R. J. Hank as manager and research engineer. Mr. Hank was formerly Texas state highway engineer.

Permanent organization will be effected in 60 days at a meeting called for Dallas. Until that time Mr. Hank will maintain temporary quarters in Austin.

Temporary officers elected by the Southwestern division were E. C. Dodson of the Chico Stone Products Co. of Dallas, president; E. Eikel of the Dittlinger Lime Co. of New Braunfels, vice-president; W. F. Wise of the Texas Trap Rock Corp. of San Antonio, secretary-treasurer.

Other crushed stone firms represented who attended the meeting were the Strington Crushed Rock Co. of McAlester, Okla.; Hall Brothers of Brownwood, Landa Rock Products Co. of New Braunfels, New Braunfels Limestone Co. of New Braunfels, and the Thurber Earthen Products Co. of Thurber. Louisiana and Arkansas firms will be invited to join at the Dallas meeting.

Valley Portland Cement to Prospect Holdings

THE Continental Drill Co. is prospecting holdings of the Valley Portland Cement Co. at Three Rivers, Calif., purchased several years ago from Marks Brothers. Cores are being taken under the direction of F. E. Linde and are being shipped to headquarters of the cement company. These drills are working horizontally into the hills, instead of vertically. According to local reports a large plant will be erected in the near future, should the prospecting prove up satisfactorily.

New Silica Sand Plant in Operation

THE first shipment of silica sand was made recently from the new plant of the Buffalo Rock Silica Co., Ottawa, Ill. This company is the latest addition to the silica sand industry of the Ottawa district and is located at the west end of Buffalo, a short distance from the Moline Consumers Sand Co.'s plant.

The deposit was stripped in part last fall and switch track, construction work done and modern machinery installed. The company is owned by Carl Gottfried of Chicago and Peter Vanrigt, who was former general manager of the Crescent Silica Co., is general manager.—Ottawa (Ill.) Journal.

Lime Convention Coming

THE EIGHTH ANNUAL CONVENTION of the National Lime Association will be held at French Lick Springs, Ind., on June 8-11. Advance reports indicate that the program will be devoted to more intensive activity in all departments. Only two outside speakers are included, and their addresses will probably be on the distribution and on the more extensive use of lime in construction.

E. G. Baker

E. G. BAKER, president of the Ohio Hydrate & Supply Co., Woodville, Ohio, for the past 7 years, and one of the best known men in the lime industry, died at his home, April 3, in his sixty-eighth year.

E. G. Baker was born in Wood County, west of Woodville, where he resided practically all of his life. His parents originally came from New England.

Mr. Baker was a graduate of Valparaiso School and later attended Michigan State University, after which he taught in both the Woodville High School and the Woodville Normal School. After marrying Linda



E. G. Baker

Herman, he engaged in farming. He was a leader of the community and became interested in banking, the telephone business, lime business, and other lines. He had served the Ohio Hydrate & Supply Co. in the capacity of president for the past seven years. He was also president of the Woodville Savings Bank and secretary of the Le-moyne Telephone Co. for a number of years.

During the World War he was chairman of the Liberty Loan Committee.

South Carolina Adopts Plan for Purchase of Cement

AT the recent conference held at Columbia, S. C., between cement company representatives and highway officials of South Carolina, a plan for future purchase of cement by the state highway department was adopted. The state will get bids from the cement companies on each project let by contract and give the contractors an opportunity to submit alternate bids based on cement furnished by the contractors.

At the conference, several other methods were discussed pro and con by the various members present. The cement companies represented were: Lehigh Portland Cement Co., Clinchfield Portland Cement Corp., Virginia Portland Cement Corp., Atlas Portland Cement Co., Dixie Portland Cement Co., National Portland Cement Co., Georgia Cement and Stone Co. and the Carolina Portland Cement Co.

Fuller Company to Handle Cement Pumps

THE Fuller Co., Catasauqua, Penn., has been organized for the purpose of handling the Fuller-Kinyon system of pumping materials other than pulverized fuel. J. W. Fuller, president, announces under date of April 1:

"In connection with the recent sale of the Fuller-Lehigh Co. to the Babcock and Wilcox Co. this part of the business was not included. The Fuller-Lehigh Co. however has been granted the exclusive rights to this system for conveying pulverized fuels only, and all matters pertaining to the conveying of pulverized fuel should be taken up with the Fuller-Lehigh Co., Fullerton, Penn.

"P. F. Stauffer, formerly sales manager of the Fuller-Lehigh Co. has taken the position of sales manager of the Fuller Co., and the balance of the Fuller Co. organization consists of experienced Fuller-Kinyon pump engineers and operators.

Changes in Personnel at Sun Portland Cement Company

SEVERAL changes in the management of the Sun Portland Cement Co., Portland, Ore., have been made recently. H. L. Knappenberger, plant manager, has been advanced to general manager and treasurer. The retirement from the organization of George MacDonald, vice-president and treasurer and C. T. W. Hollister, sales manager, was announced. The new personnel of the company follows: H. A. Ross, president; H. L. Knappenberger, treasurer and general manager; E. T. McCaslin, assistant secretary, and E. E. LeClaire, sales manager. The company has offices at 802 Wilcox building, Portland.—Baker City (Ore.) Herald.

News of All the Industry

Incorporations

Roy Sand and Gravel Co., Detroit, Mich., \$50,000.

Consumers Sand Co., Kansas City, Mo., \$100,000 to \$2,500,000.

Duntile Mfg. Co., Newton Hook, N. Y., \$100,000. A. E. H. and F. M. Wheeler.

Gulf Concrete Pipe Co., Houston, Texas. Increased capital from \$20,000 to \$80,000.

Southern Sand Co., Columbia, S. C., \$5000.

W. S. Nelson, E. W. Mullins and others.

Phoenix Gravel and Sand Co., New Orleans, La., \$50,000. Paul F. Jahncke and others.

Olean Cement Products Co., Schenectady, N. Y. Increased capital from \$15,000 to \$50,000.

Harter Marblecrete Stone Co., Oklahoma City, Okla. Increased capital from \$5000 to \$25,000.

Harbor Sand and Gravel Co., Aberdeen, Wash. Increased capital stock from \$15,000 to \$75,000.

Gonzales Cement Works, Inc., Gonzales, Texas. Increased capital stock from \$40,000 to \$65,000.

Earlville-Hugo-Stewart Lake Sand Co., Cleveland, Ohio, \$1000. Joseph P. Bender and others.

Santa Fe Sand Co., Stillwater, Okla., \$10,000. Theo. Cudgel, A. M. Morrison and Paul Winterseen.

Tiffany Sand and Gravel Co., Milwaukee, Wis., \$125,000. George Paine, A. Mueller and R. A. Dake.

Little Missouri River Gravel Co., Murfreesboro, Ark., \$100,000. J. R. Cox, G. W. Welcher and L. Cox.

Bellaire Sand and Gravel Co., Bellaire, Ohio, \$50,000. J. E. Green, J. E. Griffin, C. L. Bolt and others.

Rusciano Cement Block Co., New York, N. Y., \$5000. G. and J. and A. Rusciano. (Attorney, J. H. Marino, 41 East 42nd street.)

United Stone Products Co., Joplin, Mo., Mercer Arnold, 701 Joplin National Bank building, and others.

Nashville Brecko Block and Tile Co., Nashville, Tenn., \$60,000. Vernon S. Tupper, 101 Taylor street, Nashville.

Builders Cement Products Co., Burlington, Mass., \$25,000. L. H. Earle, A. R. Kirkpatrick and E. S. Earle.

McHugh Sand and Gravel Co., Inc., Brooklyn, N. Y., \$1000. M. A. Plunkett, 148 Linden boulevard, S. Nicholson and L. Jancor.

Standard Sewage Pipe and Septic Tank Corp., Miami, Fla. John K. Stark and others; to manufacture cement products.

Indiana Limestone Co., Bedford, Ind., \$1000. A. E. Dickinson, F. E. Bryan and F. S. Whiting. To buy, sell, quarry and deal in limestone.

Oaks Sand and Gravel Co., Bayside, N. Y., \$10,000. G. W. Henschel, A. Williams and F. Morgenweck. (Attorney, F. L. Giusti, Bayside.)

Montauk Sand and Gravel Corp., Montauk, N. Y., 300 shares no par value. A. Pearson, E. Ringwood and F. Hoerger. (Attorney, J. Rogers, Mineola.)

Suburban Land and Stone Co., Saugus, Mass., \$10,000. J. E. Lonergan and others. Correspondent, E. J. Lonergan, 250 Clifton street, Malden, Mass.

Duntile Builders Supply Co., Inc., Miami, Fla., \$250,000. J. T. Vickery and others. To own and operate plant for manufacture of Duntile and other cement products.

Economical Sand and Gravel Co., New York, N. Y., \$20,000. N. de Stefano, T. Sneec and L. Vignola. (Attorneys, Elliott and Robeson, 277 Broadway, N. Y.)

Security Sand and Gravel Co., Chicago, Ill., \$175,000. G. A. Lloyd, A. A. Owen and F. C. E. Lundgren. Correspondent, Fisher, Boven, Kales and Bell, 134 South LaSalle street, Chicago.

Lake Shore Sand and Stone Co., Milwaukee, Wis., 750 shares preferred, \$100 par and 7500 shares common of no par value. James Quarles, Charles Quarles and A. M. Kaas.

Quarries

Haines Canyon Rock Co., Tejuja, Calif., are installing new machinery and improving their plant.

Iowa State Reformatory, Anamosa, Iowa, is to install a pulverizer and other equipment at their quarry for making ground limestone for agricultural purposes.

Federal Crushed Stone Co., Minneapolis, Minn., has changed its name to Minnesota Quartzite Co. A. L. Jepson of Minneapolis is president, and

W. C. Wright, Jasper, Minn., is secretary and treasurer.

A premature explosion at the Consumers Co. quarry at Lemont, Ill., killed one worker and injured another. The 1200 lb. of dynamite had been placed in 12 holes and wires were being connected to set it off from a mill house at a distance. The blast occurred while the two workers were connecting the wires.

Sand and Gravel

Island Sand and Gravel Co., Columbus, Ohio, has secured a river shore site almost in the heart of the city's building operations. The natural topography is said to permit the storage of 250,000 tons of material with gravity loading. Plans are being perfected and equipment selected for a plant capacity of 5000 tons per day.

Ohio River Gravel Co., Marietta, Ohio, is to erect a garage and shop at a cost of \$3000.

Steen-Ellis Co., Lankershim, Wash., have purchased the Corder and More gravel pit at Lankershim consisting of 10 acres, for a cash consideration said to be \$36,000.

Drew Gravel Co., Delight, Ark., has purchased 20 acres of gravel land adjoining the site of the present plant. The plant which is now operating on leased land, will be moved to the site purchased within a short time.

Amite River Sand and Gravel Co., Denham, La., has started operations and is now producing about 20 cars daily.

Gypsum

F. C. Porter, Vancouver, B. C., is to open and develop his gypsum deposit at Canford, B. C. The quarry will supply gypsum for the British Columbia Cement Co., which has contracted for about 4000 tons.

Standard Gypsum Co.'s steamer, J. A. Perkins, arrived recently at the Long Beach, Calif., plant from San Marcos Island with 8000 tons of gypsum on board. It also towed the barge Griffon which carried 5000 tons of gypsum rock. It was the first gypsum carrying trip for the barge. The cargoes will be distributed between the Long Beach and San Francisco plants of the company.

Lime

Holland Lime Co. is about to start operations at their plant near Sheffield, Ala.

Cement

Dewey Portland Cement Co. was recently granted permission to place a spur track across the road from the Rock Island railroad tracks to the new plant being built at Davenport, Iowa.

Coplay Cement Mfg. Co., Coplay, Penn., at its recent annual stockholders' meeting, elected the following directors: Abraham Israel, James J. Burns and Harry Woolever, Philadelphia; Eugene Blum, H. E. Steiner, Sol Korn, L. H. Burton, Morris Meyer, Walter J. Wolf, B. J. Weil and L. M. Loeb, New York; E. F. Meyer, Chicago, and G. W. Newgarden, Washington.

Phoenix Portland Cement Co., Birmingham, Ala., is to erect a 60x350-ft. building, one story in height, to cost about \$75,000 with equipment, at its Powderly, Ala., plant.

Cement Products

Standard Building and Roofing Supply Co., Medford, Ore., is to install machinery for the manufacture of cement brick and block under the Shope process.

Rudolph Gustafson, Jamestown, N. Y., is to erect a cement products plant, 40x24 ft., and install modern equipment. Cement facing block will be made under license.

Ready Mixed Concrete Co., Pittsburgh, Penn., is to erect a one-story plant and install mixing, conveying and other equipment.

Rackie Stone Co., Los Angeles, Calif., is about to begin erection of a 95x95-ft. stone casting shed.

Feldspar

Golding Sons' Co., Trenton, N. J., who recently acquired the Erwin Feldspar Corp., Erwin, Tenn., has purchased a power site on the Nolichucky river, near Johnson City, Tenn. It is planned to develop hydro-electric power which is to be used in part for the mill operation. Extensive addition to the grinding departments of the Erwin mill are also planned.

Slate

Hydeville Slate Co.'s finishing shop at Hydeville, Vt., was damaged by recent fire believed to have started from a kiln. A carload of finished slate was also damaged. The total loss is estimated at \$8000.

Talc and Soapstone

Soapstone Products Co., Grassland, Penn., has acquired a three-acre site near Oakmont on which they are planning to build a new plant to cost \$75,000.

Miscellaneous Rock Products

Ambler Asbestos Co. is installing complete equipment for the manufacture of asbestos shingles, including machinery recently developed for the making of these shingles in tapered thicknesses, in its new factory at Asbestos, Penn. The product of the company is marketed by the Asbestos Shingle, Slate and Sheathing Co., of Ambler, Penn.

American Magnastone Corp., Ottawa, Ill., is moving its main office to the plant at Ottawa.

Rock Asphalt Corp.'s new plant at Cherokee, Ala., is about to start operation. The initial output will be about 1000 tons daily of crushed asphalt which later will be increased to 2000 tons.

Coquina Co., National Gardens, Fla., is to expend about \$26,000 on additional equipment and to increase the present capacity from 275 to 600 tons of coquina rock daily. Two cranes, 20 1½-vd. steel cars, one Whitcomb locomotive, Ingersoll-Rand units, etc., are among the new equipment to be installed.

Personals

A. G. Fleming, chief chemist for the Canada Cement Co., Ltd., was elected president of the Society of Chemical Industry, Montreal section, at the recent annual banquet and meeting at the Queen's hotel.

Francis A. Emmons, for the past two years advertising manager of Foote Bros. Gear and Machine Co., Chicago, has recently been appointed sales manager.

Carl Schweikert has been put in charge of the Bloomington, Ill., office of the McGrath Sand and Gravel Co. Mr. Schweikert succeeds Paul M. Coogan, who recently resigned.

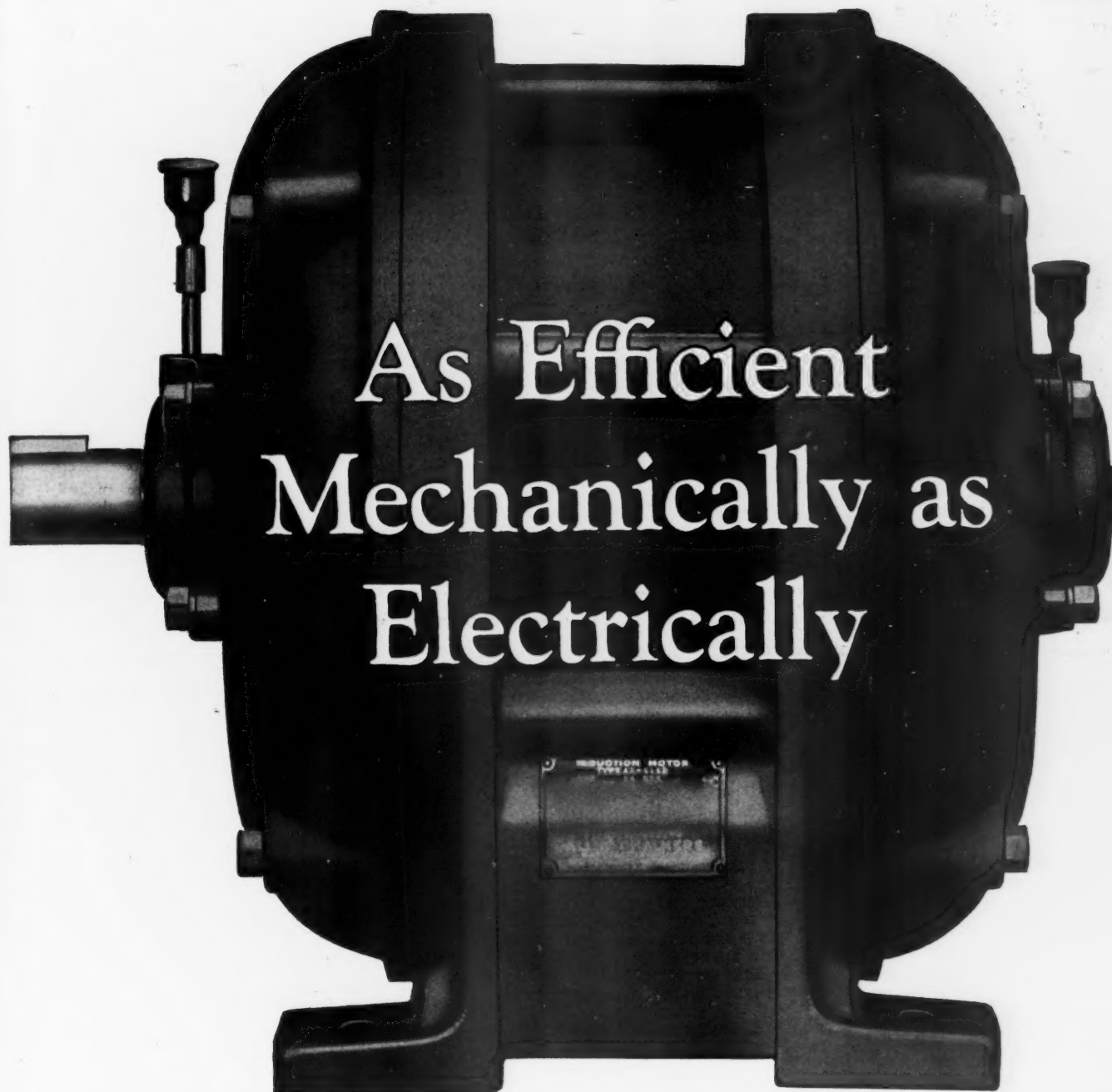
Lee Collins, assistant state geologist for Tennessee for the past year, is to leave on July 1 to continue his post-graduate work at the Johns-Hopkins university.

Walter E. Brown has joined the staff of the John S. King Co., Inc., Cleveland, Ohio, as production secretary. Mr. Brown was formerly assistant advertising manager of the Billings-Chapin Co., paint manufacturers of Cleveland.

Dudley Chandler, sales manager of the Oro Grande Lime and Stone Co., and a director of the Los Angeles Building Material Dealers' Credit Association, of Los Angeles, Calif., has been elected treasurer and manager of that organization.

Manufacturers

Dayton Whirley Co., Dayton, Ohio, announces the appointment of E. C. Hingston as district representative for Chicago, with temporary headquarters at the Old Colony club, Chicago.



High efficiency over an exceptionally wide range has always been an outstanding characteristic of Allis-Chalmers electric motors. Excellent design, consistently developed, and the use of carefully chosen materials have resulted in matchless operating economy and endurance in all types of Allis-Chalmers motors.

Allis-Chalmers mechanical superiorities are emphasized in the Type "AR" induction motor equipped with Timken Tapered Roller Bearings. Their greater load area for space occupied permits shorter, more rigid shafts. Their free-

dom from friction makes it unnecessary to lubricate more than a few times yearly at the very most. Their extreme resistance to thrust, shock and every form of wear maintains the gap for the life of the motor.

In bearings, as in frames, cages, windings, fan, and every other factor of design and construction, each type of Allis-Chalmers motor represents the higher value made possible by the scope of Allis-Chalmers activities, and by the wide acceptance of Allis-Chalmers products. Send for Motor Bulletin 1132.

ALLIS-CHALMERS MFG. COMPANY, MILWAUKEE, DISTRICT SALES OFFICES IN ALL PRINCIPAL CITIES

ALLIS-CHALMERS MOTORS

When writing advertisers, please mention ROCK PRODUCTS

Symons Bros., Milwaukee, Wis., has recently signed a contract with the Chili Exploration Co. and the Andes Copper Mining Co. for what is believed to be the largest single order for crushers. The order, which calls for the shipment of 47 vertical crushers, is to be used by the companies for their South American copper mines.

Hill Clutch Machine and Foundry Co., Cleveland, Ohio, announce that their new catalog of 125 pages covering all phases of power transmission requirements through belts, ropes and gears, will soon be ready for distribution.

Marion Steam Shovel Co., Marion, Ohio, has just issued the first number of "The Ground Hog," a small magazine which contains much useful information to operators of power shovels, cranes, etc. Other numbers of the magazine will be published in regular monthly intervals.

Fate-Root-Heath Co., Plymouth, Ohio, has placed John H. Neafie and George H. Fanning with offices at 50 Church street, New York, in charge of their district sales office for the New York territory. James A. Ridgway will continue to act as district sales representative for the New England territory.

Robert June Engineering Management Organization, Detroit, Mich., has moved to larger quarters at 2208 West Grand boulevard, where it now occupies the entire building. This is the organization's fourth move in four years to larger quarters.

Fuller-Lehigh Co., Fuller, Penn., has closed contracts with the West Penn Cement Co., Butte, Penn., for two Fuller-Randolph vertical coal driers, two 6-in. Fuller pulverized coal feeders for two kilns and one 6-in. Fuller-Kinyon pump with 4-in. conveying system for transporting pulverized coal from the mills to the bins. The company has also obtained a repeat order from the Atlas Portland Cement Co., Leeds, Ala., for one 57-in. Fuller-Lehigh pulverizer mill, screw type.

W. G. Toepfer and Sons Co., Milwaukee, Wis., are moving to larger quarters at 95 30th street, which will also increase facilities for service.

Trade Literature

NOTICE—Any publications mentioned under this heading will be sent free unless otherwise noted, to readers, on request to the firm issuing the publication. When writing for any of the items kindly mention ROCK PRODUCTS.

Lubrication. February number of Lubrication, containing much information on chassis lubrication and lubricants. Illustrations and sketches explaining lubricating devices and parts of chassis, etc., and the application of lubricants to different parts. THE TEXAS CO., New York, N. Y.

Buchanan Crushing Rolls. Bulletin No. 130 illustrating and describing Type C crushing rolls. Table of sizes, capacity details, data on foundations, etc., 16 pp., 8x10 1/2 in. G. G. BUCHANAN CO., New York, N. Y.

Electric Arc Welding. Bulletin No. 133 showing sizes and types of arc welding machines with details of construction, operation and list of accessories. BURKE ELECTRIC CO., Erie, Penn.

Small Gasoline Hoists. Bulletin No. 1525 on single and double friction drum hoists of 10 and 18-h.p., respectively. Illustrations and details of design, specifications and general description. S. FLORY MFG. CO., Bangor, Penn.

Rogers Heavy Duty Trailers. Illustrated bulletin on the 4, 6 and 8-wheel types showing their various uses. ROGERS BROTHERS, Albion, Penn.

Universal Cranes. Folder No. 208 called "7 League Boots" on the mobility of 5-ton cranes manufactured by UNIVERSAL CRANE CO., Cleveland, Ohio.

Nickel Steel. Pamphlet on the uses and advantages of alloy steels made with nickel. INTERNATIONAL NICKEL CO., New York, N. Y.

Hoists—Dragline and Slackline. Bulletin No. 130 describing in detail and illustrating Mead-Morrison dragline and slackline hoists. Data on capacities, etc., 12 pp., 8 1/2 x 11 in. MEAD-MORRISON MFG. CO., Boston, Mass.

Facsimile Charts, Scales, Etc. Bulletin on Type S recorders. Specifications, data on design, capacities, etc. CHARLES ENGELHARD, INC., New York, N. Y.

Mine Pumps. Bulletin on selection and application of centrifugal pumps to mine pumping. Instructions on design of piping, calculation of future head power, etc. Details of construction, illustrations, etc. DE LAVAL STEAM TURBINE CO., Trenton, N. J.

Speed Reducing Units. Catalog illustrating and describing different types and sizes of speed reducing units manufactured by PHILADELPHIA GEAR WORKS, Philadelphia, Penn.

Storage of High Explosives. Explosives service bulletin containing recommendations as to the location and construction of magazines for the storage of explosives, blasting accessories, etc. E. I. du PONT de NEMOURS AND CO., Wilmington, Del.

A Story of Quarry Operating Development

AS a part of their attractive and interesting new catalog of all-steel blast-hole drills, the Armstrong Manufacturing Co., Waterloo, Iowa, tells an interesting story of the progress made in quarry operating methods during the 59 years' life of this organization. We quote from this story a brief extract as follows:

In the first stone quarry the writer ever visited the operator was using small hand drills and steel-pointed iron wedges with very long taper. A row or series of holes were drilled by hand, after which wedges were set in the holes, driven down with heavy sledges, and the stone broken off. To protect the edges of dimension stone a "plug and feather" was used. In that way the quarryman could crack off a block of stone just about the size desired—but it was a tedious process. It required long and patient work.



A few years later they were using longer, heavier hand drills, cutting the holes 2 1/2 to 3 ft. deep, tamping in a charge of blasting powder and using an ordinary fuse. That was a step in advance and met the demands of the time; but, how far would concrete construction or paving jobs go now if the crushed stone had to be quarried in that crude manner and broken by hand?

Then came the piston drill and the use of high explosives. Piston drills were an innovation—a long step in advance—and are still used, especially in the production of dimension stone.

For general quarrying, however, piston drills had their limitations in that their use required the drilling of many small holes and the shooting of the ledge in benches.

Origin of Big Hole Drills

About this time portland cement began to come into universal use—cement and crushed stone—in construction work, in the building of bridges, large buildings and in the paving of roads. The introduction of portland cement and the extensive use of crushed stone so increased the demand on the quarry industry that greater and more economical production was absolutely necessary. Quarrymen realized the seriousness of the situation and while casting about for a way out of the difficulty some bright mind conceived the idea of cutting larger holes, fewer in number, to the bottom of the ledge, firing in series and shooting the whole face of the cliff at one shot.

Use of Well Drills

That was easier said than done just then, yet the principle was recognized as being the correct one. Such a plan, however, involved the use of a heavier type of drill

and the only heavier drilling machines available were the water-well drills then in use. They were neither designed for nor adapted to this class of work, but clumsy as they were, experiments showed that big blast holes and big blast hole drilling was what the quarry industry needed to keep production up to demand.

By this process, by drilling big holes to the foot of the ledge and using a number of charges of high explosives, thousands of tons of rock could be blown down just as easily as hundreds of tons were blown down before.

This plan of quarry operation involved the drilling of fewer holes, larger and deeper holes, with drilling machines of greater capacity. It saved labor, gave endless production, kept ahead of the crushers and gave promise of revolutionizing the quarry industry. Today big blast hole drilling is recognized as standard practice, and where the large operators of those days were content to use one drill, now plants operating five, 10, 15, 20 or more drills are more or less numerous, while even the smaller local quarry is operating one or more big blast hole drilling machines and the quarry industry has taken on new life and big construction projects are carried through to completion with a speed and efficiency never before dreamed possible—and it is all made possible because the quarry of today is able to deliver in steady volume.

Development of Special Blast Hole Drills

The development of big blast hole drilling led to the introduction of special big blast hole drilling machines of a size, strength and capacity in keeping with the hard grind they had to withstand and to meet the requirements as to the production of footage.

Big blast hole drills gained in use steadily even though the first machines were little more than water-well drills of a larger or stronger type.

First Drills Mounted on Skids

All the drills in use were built of wood—wood frame, wood derrick—and the earlier types were mounted on skids and had to be dragged from one location to another. In the early stages, too, they were operated by horse power just as the old-time threshing machines were operated. Later on steam power—a separate boiler and engine—was used. Then our company made a big step in advance by building a portable rig—we put our drilling machine on wheels so that it could be moved about with greater ease and less labor. Then we built the first drilling rig with the boiler and engine mounted on the frame of the machine—the whole thing, power plant and drilling rig mounted on wheels, in one portable unit, easily moved and always ready for work. This saved all the time, trouble and labor of moving the drilling rig and getting it set up, of moving and setting the power plant in line. These improvements in design which were later adopted by other drill manufacturers were the greatest forward steps that had been made in blast hole drilling equipment and were but the forerunners of still greater advancements soon to follow.

The next innovation came with the perfecting of the gasoline engine, when we put out the first drilling rig powered with a single cylinder gasoline engine mounted on the frame. No wood to chop, or boilers and flues to clog with lime—just gasoline and plenty of power. After having demonstrated the practicability of gasoline engine power, we were the first again to equip drilling machines with multiple cylinder gasoline engines which produce an even, flexible flow of power, dependable under all conditions.